AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS, AND BLACKSMITHS.

VOL. 9, No. 51
WEEKLY.

NEW YORK, DECEMBER 18, 1886.

$2.50 per Annum.
SINGLE COPIES, 5 CENTS.

COPYRIGHT 1886, BY AMERICAN MACHINIST PUBLISHING COMPANY.

For Sale Everywhere by Newsdealers.

ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Double Spindle Variety Moulder.

We illustrate on this page a double spindle variety moulder just brought out by J. S. Graham & Co., Rochester, N. Y. It is a strong, durable machine for producing all kinds of irregular mouldings of the finest finish in piano, organ and cabinet factories, car and agricultural implement shops, and other similar establishments. It is designed to perform the heaviest work in a rapid and economical manner without vibration or tremor.

The frame is very heavy, cast in one piece cored out, and has the spindle-box slide bearings cast to the side forming a part of the frame. The base is very wide, preventing any vibration and securing solidity.

The hollow column is fitted with a door and shelves, forming a case for the reception of tools, wrenches, heads, cutters, etc. The spindle boxes and slides are one casting. They are planed on centers and held in frame by large gibs and sliding surfaces. They are adjustable vertically by hand wheels in front of the frame in connection with a new adjusting device, that requires no lock to hold it at the proper height.

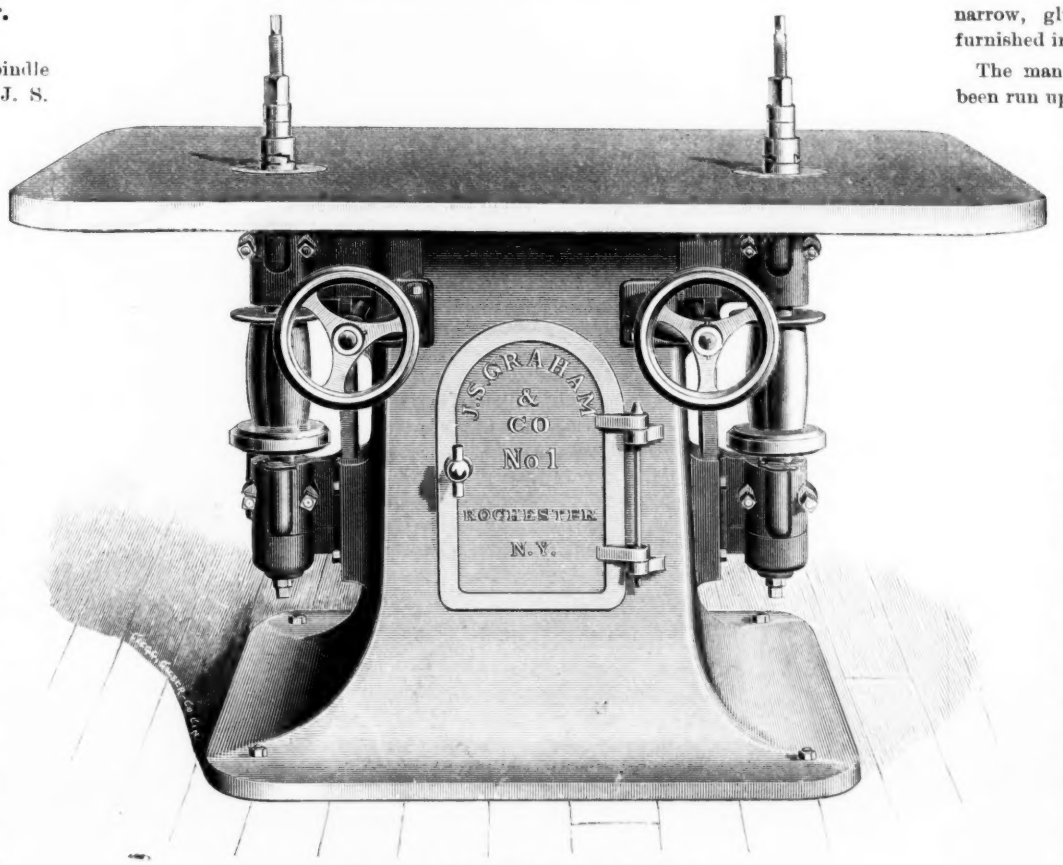
The lower box is fitted with patent self-oiling and adjusting step, which is made to stand under the highest kind of speed.

The spindles are 30 inches from center to center, and have independent screw tops, enabling the operator to have various sizes for large or small work or to clear the table of either spindle for any special work.

The iron table is 5 feet by 4 feet, planed and fitted with concentric rings around the spindles to suit various sizes and kinds of heads and cutters.

A heavy wooden table, made of narrow, glued-up strips of hard-wood, is furnished instead of iron, if preferred.

The manufacturers say this machine has been run up to 6,000 revolutions without the least perceptible jar, and cutter-heads as large as 8 inches in diameter are being used on it for heavy work with entire success.



DOUBLE SPINDLE VARIETY MOULDER.

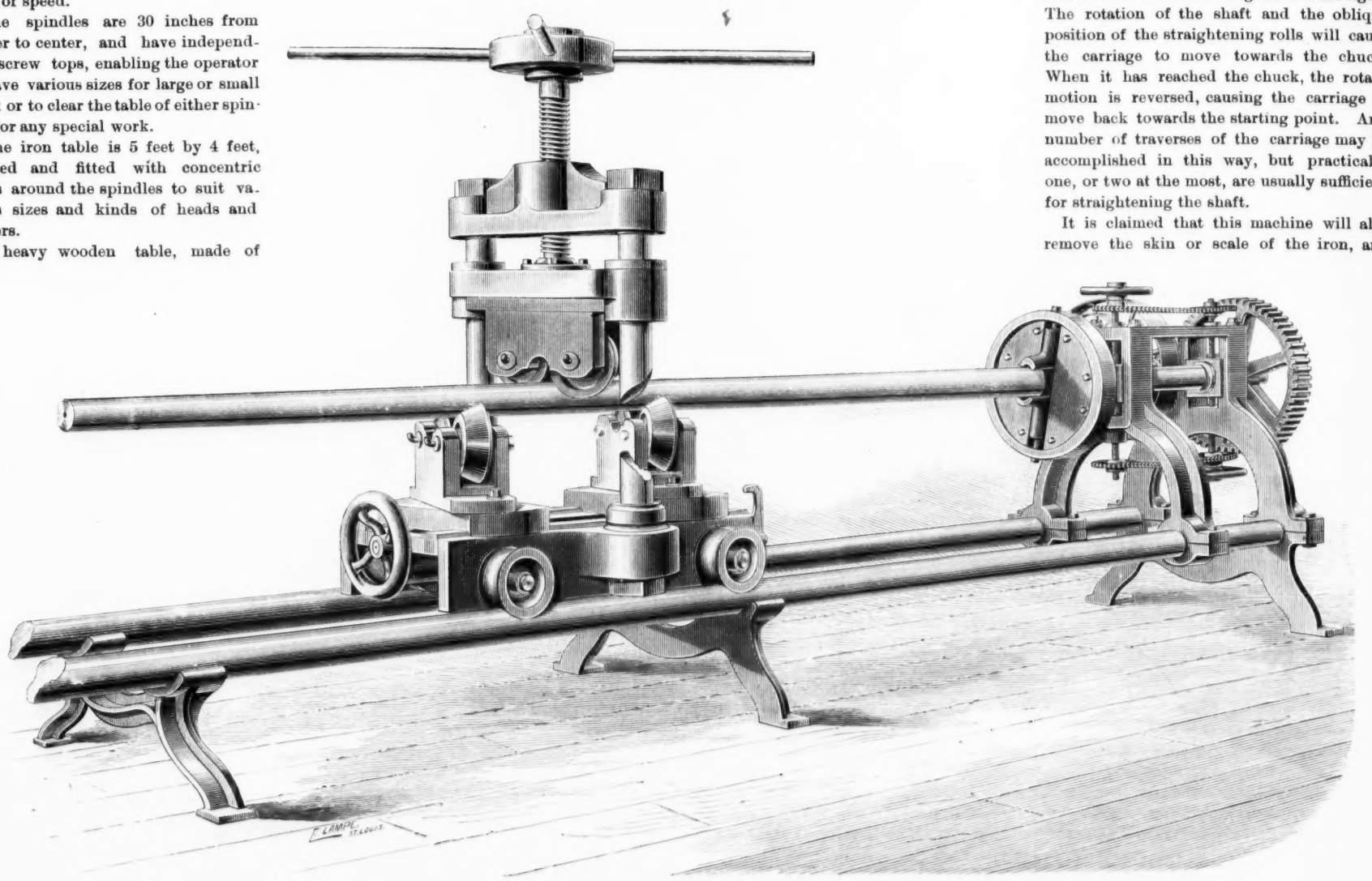
Medart's Straightening Machine.

Medart's shaft straightening machine, as represented in the illustration, is made for the purpose of cold straightening round iron and gas pipe.

This machine takes in bars from 1¼ inches to 4½ inches in diameter and 25 feet long, and can be operated by one unskilled man.

When a shaft is to be straightened, the straightening carriage is moved away from the chuck into a position corresponding to the length of the shaft to be operated upon. One end of this shaft is fastened in the chuck, and its other extreme end is allowed to rest on the rolls. The upper rollers are then screwed down upon the shaft with the desired pressure. The chuck and shaft is now set in motion turning towards the right. The rotation of the shaft and the oblique position of the straightening rolls will cause the carriage to move towards the chuck. When it has reached the chuck, the rotary motion is reversed, causing the carriage to move back towards the starting point. Any number of traverses of the carriage may be accomplished in this way, but practically one, or two at the most, are usually sufficient for straightening the shaft.

It is claimed that this machine will also remove the skin or scale of the iron, and



MEDART'S STRAIGHTENING MACHINE.

straighten the shaft more accurately than is possible by the old process, greatly facilitating the turning of the iron, since the tool cuts the same thickness of chip from end to end; consequently the lathe can be run at a much higher speed than when turning iron straightened in the old way. The bar after being turned is again run through the rolls for the purpose of removing the tool marks, and giving it a polished finish with the same operation. This is accomplished, even though the tool finish is comparatively rough.

It is also claimed that this machine will straighten a shaft 3 inches in diameter and 24 feet long in three minutes and twenty seconds, leaving the bar in the proper condition for the lathe.

When it is desirable to support the shaft as it moves towards the chuck, adjustable supports may be used, or any other suitable means for this purpose.

These machines, with supports, are manufactured by the Medart Patent Pulley Company, 1206-1214 N. Main street, St. Louis.

Practical Drawing.

BY J. G. A. MEYER.

NINTH PAPER.

In the following problems all the given lines, and lines which are to be found, will be represented by full lines. All the auxiliary lines, or which we may call construction lines, will be represented by dotted lines.

Problem 1.

103. TO DRAW A LINE PERPENDICULAR TO A GIVEN STRAIGHT LINE FROM A GIVEN POINT IN THAT LINE.

Fig. 68. Let $B\ C$ be the given straight line, and A the given point in the line $B\ C$; it is required to draw a straight line perpendicular to $B\ C$ through the given point A. In the straight line $B\ C$ mark off any point as B; from the point A as a center, and with a radius equal to the distance $A\ B$, describe a small arc intersecting the line $B\ C$ in the point C. From the point B as a center, and with any radius greater than the distance $A\ B$, describe an arc f, and from C as a center with the same radius, describe another arc e, intersecting the former arc in the point D. Though this point D and the given point A draw a straight line $A\ D$; this line will be the perpendicular required.

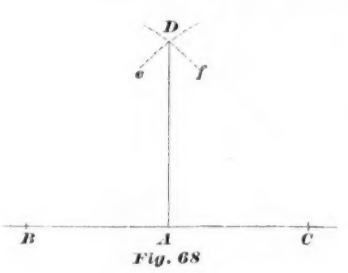


Fig. 68

The line $A\ D$ is perpendicular to the given line, because the point A is equally distant from the points B and C, and the point D is also equally distant from the same points. (See article 40.)

Directions.—This problem should be drawn on the paper in the space previously marked problem 1, as directed in article 98. We have represented in Fig. 69 this space with the given line and point belonging to problem 1 drawn in this space. This figure also represents the space allotted to the next problem with the given line and point shown in the same.

The student should commence this construction by drawing with a pencil a straight line $B\ C$ of any length, and in a position in the allotted space, similar to the position of the line $B\ C$ in the first space, Fig. 69; that is, the given line $B\ C$ must not be parallel to the horizontal or vertical division lines. This line so drawn is assumed to be the given line; in its center, or nearly so, mark off any point as A, then through the point A draw very accurately a line perpendicular to $B\ C$, according to the instruction given in the beginning of this article.

104. After the lines of this problem have been drawn with pencil, they may be inked. (See articles 91 and 92.) But if economy is to be considered, this construction need not be drawn in ink until all the constructions on the sheet have been drawn in pencil.

When a problem is to be inked, and particularly when drawings of machinery are to be inked, always ink first the arcs, circumferences of circles or curved lines, and the straight lines last; by so doing, we will obtain neater drawing, because it is always easier to make a straight line meet a curved line than to make a curved line meet a straight line.

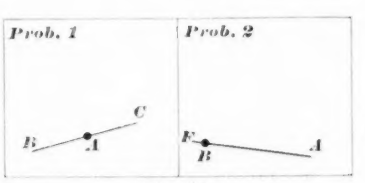


Fig. 69

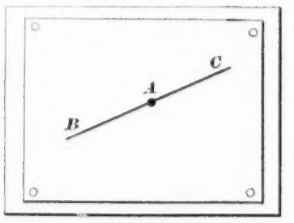


Fig. 70

105. The manner of drawing a line perpendicular to another line, or as the practical man would say, drawing a line square with another, as explained in problem 1, is called a geometrical method. Oblique lines, angles and other figures are also drawn by geometrical methods, as we shall explain hereafter. But right here the student must understand that these geometrical constructions must not be passed over lightly; a thorough understanding of these will be highly beneficial to him in more than one way. These will not only help him greatly in making drawings of machinery, but the geometrical solution of these problems are directly applicable to every-day practice.

For instance, when a full size drawing is to be made on the shop floor, which often occurs in ship yards, boiler, and carpenter shops, the geometrical method of drawing lines must be adopted, because our T squares and set squares are too small, and therefore cannot be used; and even if we could find other wooden squares (iron squares would be too heavy) we could not depend upon their accuracy. Here, then, the reader will understand the reason why we recommended in Art. 102 to dispense with the use of T square and set square part of the time, and only use a straight edge for drawing all straight lines entering into the geometrical construction of these problems; in fact, if he will imagine that he is drawing the lines on the floor, he will become acquainted with the only reliable method, which will enable him to make full size drawings on the floor, or in other words, he will learn how to lay out work.

When it is advantageous to the student to use the T or set square, we shall direct him to do so.

106. Still, as useful and indispensable as these geometrical methods are, the draftsman seeks and often adopts some special method for drawing lines on paper, which will enable him to do his work with less labor and consequently quicker. But these special methods can only be employed in such cases in which the T and set square and other tools can be used with advantage; but it must be noticed that in these cases the correctness of the constructions will depend entirely upon the accuracy of the tools used.

These special methods we shall hereafter call the "Draftsman's Method." In each of the following problems the geometrical construction will be given first, and the draftsman's method, if such is applicable, will be explained at the end of the same problem.

107. The line drawn through the point A perpendicular to the line $B\ C$ in the first problem can be drawn by the following draftsman's method.

In order to show this plainly, we will assume that an oblique line $B\ C$ is drawn on a separate sheet, as shown in Fig. 70, and that it is required to draw through the point A a line perpendicular to $B\ C$.

Fig. 71 represents the same drawing board, paper and line $B\ C$ as shown in Fig. 70.

Place on the paper the T square with the set square against the edge of the former in the position marked 1, in which the edge $d\ e$ of the set square is parallel to the line $B\ C$. Then with the left hand hold the T square firmly in this position, and with the right hand move the set square along the edge of the T square, until the edge $d\ e$ of the set square uncovers the point A and is in the position marked 2; through the point A and along the edge $e\ f$ draw a line; this line will be perpendicular to $B\ C$.

To use the T and set square quickly and with precision in the manner just explained needs practice; hence, the student's time will be profitably employed by drawing according to the draftsman's method on a separate piece of paper a number of lines perpendicular to several oblique lines, and thus make himself familiar with this manner of drawing lines,

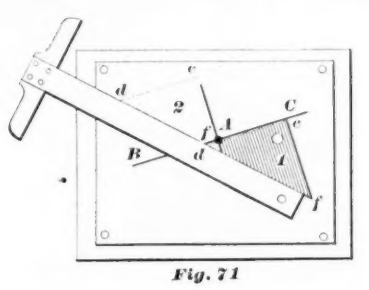


Fig. 71

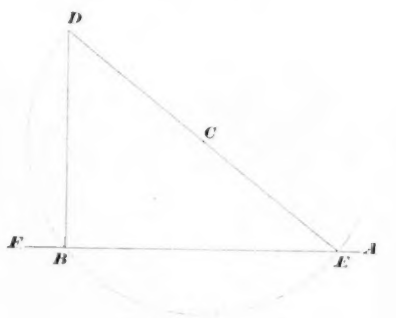


Fig. 72

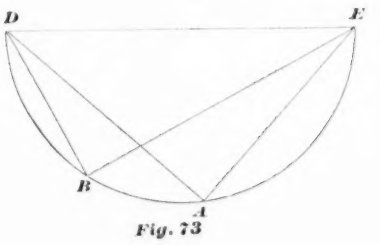


Fig. 73

and enabling him to draw these quickly and with precision.

Problem 2.

108. TO DRAW A LINE PERPENDICULAR TO A GIVEN STRAIGHT LINE FROM A GIVEN POINT IN THAT LINE; THE GIVEN POINT BEING NEAR OR IN THE END OF THE LINE.

Fig. 72. Let $A\ F$ be the given straight line, and B the given point in and near the end of the line; it is required to draw a straight line through the point B perpendicular to $A\ F$.

Choose any point as C above the straight line $A\ B$; from this point C as a centre and with a radius equal to the distance between the points C and B draw an arc of a circle $D\ B\ E$. This arc will pass through the point B, and also intersect the straight line $A\ F$ in the point E. Through the points E and C draw a straight line intersecting the arc in the point D. Through the points D and B draw a straight line; this line will be the perpendicular required.

In elementary geometry it is proved that, if from any point as B (see Fig. 73) in a semi-circumference $D\ B\ E$ chords be drawn to the extremities D and E of the diameter, the chords will be perpendicular to each other, and the triangle $D\ B\ E$ will be right angled at B.

Or, if again in the same figure chords be drawn from the point A to the extremities D and E of the diameter, the result will be the same as before, namely, the two chords will be perpendicular to each other and the triangle $D\ A\ E$ will be right angled at A.

Now examining Fig. 72 we find the arc $D\ B\ E$ is a semi circumference and $D\ E$ the diameter of the circle, and since $B\ E$ and $B\ D$ are chords drawn in a semi-circumference similar to those shown in Fig. 73, we conclude that the line $B\ E$ is perpendicular to the line $B\ D$.

Directions. Draw this problem in the space marked problem 2, and commence by drawing an oblique line in a similar position in this space as that of the line $A\ F$ in Fig. 69. Then, through the point B draw a perpendicular according the instructions given in problem 2.

This geometrical construction is very useful when a full size drawing is to be made on the floor, in which some of the lines which are to be drawn perpendicular to other lines happen to fall near a wall of the shop. In cases of this kind we cannot draw these lines according to the method given in problem 1, and consequently for this purpose a construction similar to that given in problem 2 must be employed.

Draftsmen's Method. Use the T square and set square in a manner precisely similar to that explained at the end of the previous problem.

The New York Meeting of the Mechanical Engineers.

ABSTRACT OF PROCEEDINGS.

Owing to the enforced absence of President Sellers, Vice-President Towne presided at the sessions of the society. The first meeting, Monday evening, November 29, was called late--half past eight—and the members being invited to a collation at its close, the proceedings were necessarily cut short, consisting in the main of getting formally opened.

For reasons otherwheres made plain there was no address by the President, but Horatio Allen being present was requested to address the society, which he did in an off-hand but most enjoyable manner, upon matters pertaining to the early use of steam in this country, particularly in locomotives and steamships It would be impossible in any report to do justice to the veteran engineer's remarks, but a few interesting points to which he referred may be noted: Speaking of early railroad matters Mr. Allen said that many thought railroading was imported direct from England; this was a mistake. This country did an important work in its development. He reverted to the time when he was sent to England to purchase locomotives. The Stockton and Darlington road there was being satisfactorily operated, yet eminent engineers, some of them afterwards eminent in connection with the locomotive engine, recommended that the Liverpool and Manchester railroad, then building, be operated by a stationary engine and ropes. A reward of 500 pounds had been offered for a locomotive that should draw three times its own weight at a speed of 10 miles per hour. He was so well satisfied that success was assured that he ordered three locomotives before the trial for the reward came off. He had, he said, no doubt of the success of the locomotive; the breed of horses he thought would not be materially improved, but the breed of locomotives would grow better.

Referring to steamship matters, he said one of the early questions was whether it would do to put in an ocean-going vessel an engine with only one cylinder. They built one at the Novelty works and she started on a trip to Charleston. It was thought a hazardous thing to do. Off Hatteras the ship encountered heavy gales, and the captain, like a prudent man, went out of the course to get plenty of sea room. This made the ship a day or two late at Charleston, and her non-arrival confirmed the critics in their opinions and made plenty of new critics. But when she arrived in as good shape as when

she left New York the matter of single-cylinder marine engines was settled.

When, at the Novelty works, they first put surface condensers into ocean steamships, Mr. Allen said they met with much opposition from engineers. Surface condensation had been tried in England years before and abandoned, but he considered that the failure had been on the part of the men who had the matter in charge. They put in (at the Novelty works) the surface condensers, and after a trip the engineers wanted jet condensers. They got them, but a single trip was sufficient to make them ask for the surface condensers back again.

Another difficulty was to get the adoption of an independent engine for the circulating pumps of surface condensers. It was contrary to practice to use independent engines, and so, it was argued, must be wrong.

In speaking of the substitution of the screw propeller for the paddle wheel, he said it was thought the paddle wheel must be right from its antiquity. He sketched the action of 42-foot paddle wheels with the vessel to which they belonged, heavily loaded, and found the useful action to be substantially the same as that of the screw.

The speaker spoke of the difficulty of introducing the expansive working of steam. He made a model and carried it around under his arm. He carried it to railroad men, but they, for a long time, could not be made to see that it would do at all for a locomotive. They had, at the Novelty works, a stationary engine working with an arm—substantially a link—before the link was thought of in connection with the locomotive.

Mr. Allen spoke strongly of the lack of thought on the part of individual mechanics. The evil was that the thinking powers of the young men were not properly worked up. What was wanted was to bring young men of sixteen or seventeen into the shops who would think, and who would cultivate the habit of thinking. They should have more intelligence when they entered the shops.

Speaking of a young and favorite engineer who came to him at his house for advice, he said he told him he was not sure that it was necessary to say but one thing, that was: "Be very careful what you take for granted."

At the conclusion of Mr. Allen's remarks, which were frequently interrupted with applause, that would have been more prolonged but for his habit of speaking right along, Prof. Thurston alluded to him as the oldest engineer connected with the society, if not the oldest in the country. He spoke of the indebtedness of many engineers to him for advice always kindly given, and moved a vote of thanks for his address.

Prof. Trowbridge proposed amending so as to instruct the secretary to have his remarks written out, and as amended and added to by Mr. Allen, published in the proceedings. The motion prevailed unanimously.

The committee appointed some time since to try and secure legislation by the General Government in regard to tests of material reported general discouragement, and asked to be discharged. Through their efforts a bill was introduced in Congress, and they found that a large majority of the members were in favor of its passage. But it could not be got before the House. They were told by those conversant with such matters there was no politics in it. Agreeably to request the committee was discharged.

The Committee on Standard Pipe Threads submitted a lengthy report, detailing their meeting and work with committees from associations representing pipe and fitting manufacturers. The most important part of this report is the probability of the establishment by all manufacturers of the standard recommended by the late Robert Briggs.

In the discussion of this report Mr. Bond said that samples of pipe from different manufacturers sometimes showed a wide difference in size of threaded ends; as much difference as six threads in the distance two pieces would screw into the same threaded hole was observed.

Other members spoke on the subject, detailing variations, and showing the lack of uniformity.

Mr. Sterling had sent machinery to Australia, and had left one end of pipe without thread, to be cut there for their fittings.

Mr. Bond spoke of the jump from 11½ threads to 8 as leaving the smaller sizes of the coarser threaded pipe weak, but the committee thought if they tried to reform this by changing the pitch of some of the sizes, they would be able to accomplish nothing.

Mr. Wolff thought the society should endorse the action of the committee.

Mr. Kent called attention to the fact that the society recommended the conclusions of committees, but never endorsed them.

It was thought by some that an effort should be made to establish an universal standard, or, at least, to secure uniformity as between this country and England, but it was generally thought that, owing to the almost entire lack of system in this respect in England, that this would not be practicable.

Mr. Kent thought that a description showing what the Briggs standard really was should accompany the report in the transactions of the society; the incorporation of this was left in the hands of the committee. The report was accepted.

For the Committee on Uniform Methods of Tests, Mr. Towne spoke of the great advantages of a uniform system in the way of making tests comparable. Some ten specimens had been sent out through the action of the committee to as many parties having testing machines, but the returns were so variable that no satisfactory deductions could be drawn from them. The committee had sent out more specimens—22 he believed; some of them had been returned, but not all yet. They were working to the end of securing uniformity, and hoped eventually to present some rules that would be acceptable.

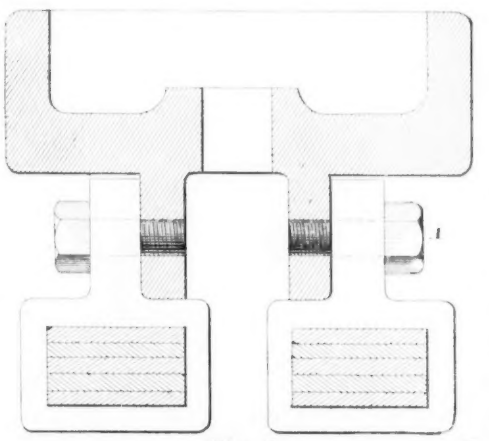


Fig. 1

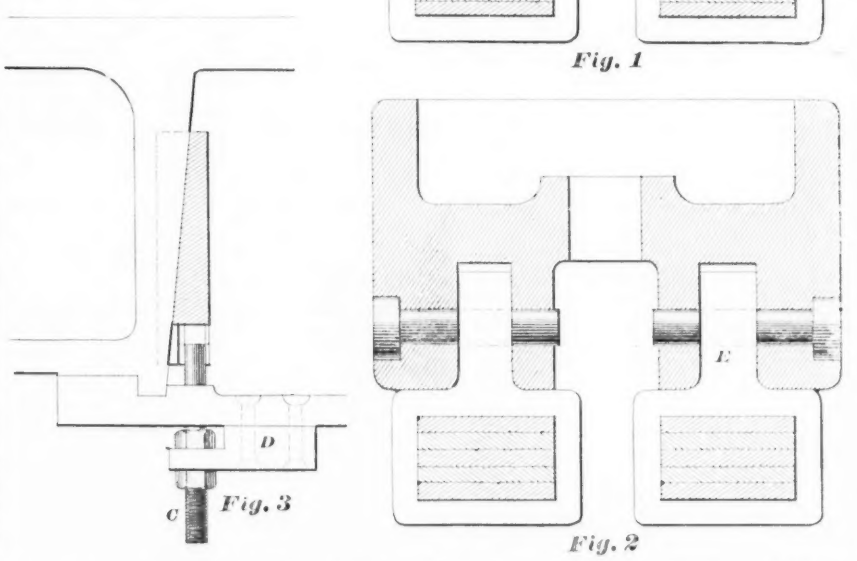


Fig. 3

Fig. 2

In reply to the question (Topical Discussions) "How should a laboratory of mechanical engineering be equipped?" Prof. Lanza thought the equipment should be on a practical basis. The student should be required to do such things, and in such a way, as he will be required to do in after practice. He should be able to carry out all tests that he would want to carry out as an engineer.

Prof. Alden thought that suggestions from the mechanical engineers then present, as to what they would like to have the student able to do, would be a valuable guide.

Mr. Towne thought the field sought to be covered too wide. The main thing was to teach him to do something well.

To "What are the best problems for students in mechanical engineering in the last year of their regular course?" Mr. Crane remarked that he frequently had assistants who lacked the ability to think so as to carry out ideas. He thought students should be required to design in a small way, and have their designs sharply criticised.

Mr. Kent thought design should come in the first year of the course. Students were not far enough advanced when they entered technical schools. They were obliged to spend their first year in learning things they ought to be familiar with before entering; if further advanced they could attend to design the first year.

Prof. Lanza realized the force of Mr. Crane's remarks. Designing must be practiced, but not too extensively. In their school (Massachusetts Institute of Technology) students had to design a boiler complete; another design was that of a line shaft, complete and for a definite purpose, power taken off here and there in its length.

Mr. Partridge thought one mistake in technical schools was in trying to impart practice, which the student could get only outside. They could get the tools in school, with instruction how to use them; but the practice they could not get there.

Mr. Henning thought that there was not sufficient preparation before entering. None but those properly prepared should be permitted to enter.

Another speaker had decided preference for those who had shop practice. He found that students did not understand workshop drawings. He thought that they should be instructed in this more practically. He found the students inclined to multiply parts, using four when only one was required. This showed lack of instruction in this direction.

"Can you give any data from your own experience as to the power required to drive modern American machine tools?" brought out the widest diversity of opinion.

Mr. Lewis, in some experiments with lathes, had often found that more power was required to drive the cone alone than when the back gears and spindle were connected. Much depended upon tool. If the feed was made equal to the depth of cut then a tool, though dull, would wedge off the metal. He had found for cutting easily the point of the tool should not be in advance, but should recede.

Mr. Babcock thought the power required in any case was small. He had driven a good sized machine shop with a two horse-power engine. Should think in the average shop one horse-power would keep ten men at work.

Mr. Doane did not think two horse-power would run much of a shop in these times, when the practice was to use strong tools, and make them do work.

Mr. Towne said at their works 62 to 75 horse-power was required for 500 men.

"What are the best conditions for flying rope transmission of power; are there limitations to its use?" brought out the difficulty of vibration between pulleys, and the suggestion of various possible remedies.

Mr. Giddings had this kind of experience with vibration, and it was remedied by turning the filling in the groove, so that it ran entirely true with the shaft on the journals. The suggestion was by Prof. Sweet. Since then, at which time he was a student at Cornell, he had been able to corroborate the correctness of Prof. Sweet's plan. But he had recently found that manilla rope was better than the wire rope.

Others spoke in favor of of manilla rope, and against the use of wire.

Mr. Towne agreed with Mr. Giddings as to cause of vibration. He had found that for inside work cotton rope was better than wire. No filling of pulleys was required, a V groove being turned for the rope; for carrier a half round groove was turned. The cotton rope could run at higher speed than the wire, in the proportion of 5 to 2.

Following are the officers elect for the ensuing year:

President, George H. Babcock; Vice-Presidents, Joseph Morgan, Jr., Charles T. Porter, Horace S. Smith; Managers, Frederick G. Coggin, John T. Hawkins, Thomas R. Morgan, Sr.; Treasurer, William H. Wiley.

Railroad Shop Notes.

We herewith represent one of the improvements made by Mr. Charles A. Ball, master mechanic of the Brooklyn Elevated Railroad, in the mechanism of the locomotives on that road. Fig. 1 represents the engine truck center casting as it was originally made by the Rhode Island Locomotive Works. In this design the spring is fastened to the center casting by the screw bolt *A*; and consequently the greater part, if not the whole weight which the spring has to support is thrown on this bolt. The result is that the screw bolt *A* will become loose and often break.

Fig. 2 represents the improved center casting. Here it will be seen that the lug *E* of the spring band fits into a bocket, and the casting rests on the spring band; consequently the whole weight which the spring has to support is thrown directly on the center casting, relieving the pin *B* from all strain. This pin is not tapped into the casting, but is prevented from moving out of its position by a casting in which the engine truck center casting is made to work; and is used only for the purpose of holding the spring and center casting together, when it becomes necessary to lift the engine.

By making the casting as shown in Fig. 2, a great many annoying delays have been avoided, and the expenses of repairs greatly reduced.

In these locomotives it was found that the room in the pedestal in which the loose wedge could be moved was too small; and since some of our readers may have a similar difficulty to contend with, the following description of the simple method for overcoming this difficulty adopted on this road may be interesting to them. Previous to the adoption of this method the wedge bolt *C* passed through the pedestal cap (not tapped into it) with a nut above the cap to prevent the bolt and wedge from slipping downward. But with this arrangement the loose wedge could not be moved as low as desirable, the nut being in the way.

In order to gain the space occupied by this nut, a bracket *D*, (Fig. 3), with a lug forged at one of its ends, was riveted to the underside of the pedestal cap. The bolt *C* is passed through the bracket *D*, and the nut which was previously placed above the cap is now placed above the lug of the bracket, thus obtaining more room than before for the adjustment of the wedge. With the adoption of this method no change is made in the wedge or pedestal cap.

A Generous Gift that Should be Appreciated.

As was well known the late Mr. Hoadley was in possession of many valuable instruments and scientific apparatus used by him in expert tests. It becoming known, at the recent meeting of the Society of Mechanical Engineers, that these instruments would be sold, Mr. Stephen W. Baldwin telegraphed that he would be the purchaser, and forthwith presented them to the society.

Moulding Pulleys.

BY ROBERT E. MASTERS.

When moulding pulleys in green sand from a band pattern, or striking them up in loam with dry sand cores for the arms and hub, where a pulley of the same size with hubs and arms of the same size is required every now and then, it is a good plan to have the arm and section of the hub made in a core-box in one piece, but when the hubs have to be made of different sizes (to suit the shaft) in a pulley of the same diameter this plan will not answer.

Figs. 1, 2, 3 and 4 illustrate a method of making a set of arm and hub cores for a half dozen size pulleys, say from 5″ to 60″ inclusive, thereby avoiding the necessity of having so many different core boxes; another advantage in making pulleys on this plan in small foundries where there is no crane, is, there are no heavy cores to lift, as must be done where arm pattern and lifting plates are used.

Figs. 1 and 2 are longitudinal and cross-section views of the arm core box with the core rammed up and turned over ready to lift the core box off, *A A* is half of the arm fastened to the bottom of the core box, *B B* are wrought iron rods to strengthen the core, the dotted lines *C* represents a block set in to make a shorter set of arms. Fig. 3 is a plan of the hub core box, and Fig. 4 is section of the upper half of the hub core from *D* to *D* rammed up and turned over, showing the gates *E* which have been set and drawn before turning over. Of course in the lower half of the hub core the gates are left out; *F F* are cast or wrought iron rings.

It will be seen that any size hub used in the ordinary way of making a pulley can be used in this core box, having a hole bored in the center of the section of the arms *G G* for the dowel on the hub *H*. If a heavier or a lighter set of arms is wanted *A* and *G* can be taken out and replaced with whatever is thought suitable.

Fig. 5 shows the moulding of a pulley on this plan from a band pattern, the strike *I* forming a seat for the arm and hub cores. To illustrate, if a pulley 15″ face is needed from an 8″ band, the arm cores are 3″ deep and the hub core 6″ deep, the strike would be 3½″ to the shoulder at *J* and 3″ deeper at *K*. This would bring the top of the lower set of cores level 7½″ from the bottom of the rim, or in the center of the pulley. The strike is cut to fit snug inside of the band at *L* and that part of the strike which forms a seat for the hub core must be the same width as the inside of the core from *M* to *M*. This will leave a space at *M* when the hub core is set which can be easily filled up with sand, level with the seat for the arm cores.

After the bottom arm cores have been set and the joint between them and the hub core dressed up with some stiff blacking, set in the center core and the top hub and arm cores can be put on, the balance of the pulley rammed up. In ramming over the top hub core a vent wire can be put in the vent hole *O*, to prevent the sand getting in, or a piece of pasteboard can be placed over it, to be removed when the cope is lifted off. This will leave the vent free and open.

Although it is not very often that orders are given for double arm pulleys, two sets of arms can be made in a pulley on this plan, either with separate hubs to each set of arms or the hubs connecting between the arms. Another plan for a double arm pulley, where there is a set of arms for the band, is to make the lower set of arms with cores as described, and the upper set with the arm pattern, and lifting plate same as in moulding a pulley with a single set of arms.

When making a pulley with a broad face it is important when drawing it up to keep it plumb. To do this be sure that the band sets level to start with. When rammed up to the top of the band, make a level parting in three or four places flush with the top of the band, then set on each of these places (which are equal distances apart) close to the band, inside or outside, a block of wood, 1″ square, 2″ deep, or whatever depth is to be drawn at a time. If the band is drawn level with the top of these blocks they will be something of a guide to go by. The safest plan is to use a spirit level each time the band is drawn up.

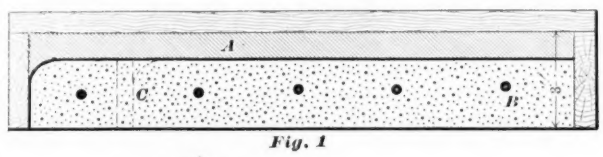


Fig. 1

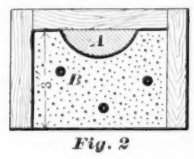


Fig. 2

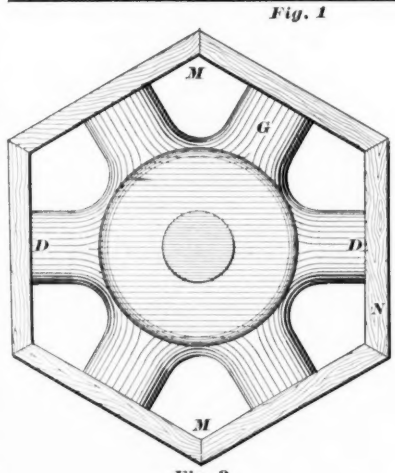


Fig. 3

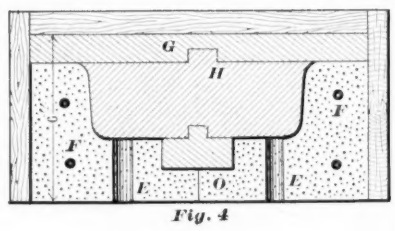


Fig. 4

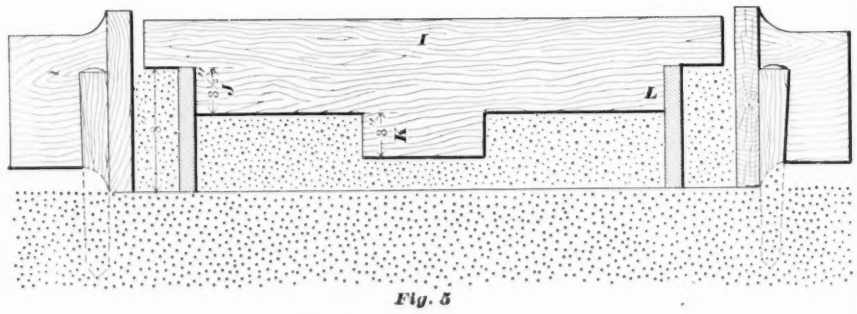


Fig. 5

MOULDING PULLEYS.

Return Tubular Boilers.

BY WILLIAM LOWE.

DOMELESS BOILERS.

The several kinds of stationary steam boilers may be used without domes and give satisfactory results in quality of steam and other requirements, by furnishing them with the necessary appliances in kind of nozzles, and internal dry or foam pipes, or plates, which will prevent the draft of steam from them, drawing up water with it into the nozzle or outlet for steam. Domeless boilers of the common horizontal tubular kind are in extensive use, and in order to get as much steam room as may be allowed in them, and carry the water line as far from the nozzle outlet as is advisable, the tubes are placed low down and near each other. With this arrangement it is assumed that dry steam may be, or rather is, obtained from this type of boiler under these conditions; but the evidences in tests, and annoyances from wet steam from them, are proof that the expectation and assumption are incorrect, and in consequence of the poor quality of the steam furnished by these boilers, various devices in dry pipes, foam plates, separators, and lay-outs of, and number of tubes, are offered as remedies in order to get steam as dry as possible, when the boilers are doing their reasonable rating in horse-power. It is in evidence that these boilers having the customary number of tubes, and doing their reasonable rating, according to their heating surface, will foam or prime, and carry more water out with the steam than any other kind of boiler on the same system. Therefore, there are those who assume that less number of tubes should be used in them, to remedy this difficulty or fault, by giving a freer circulation, and say that the reduced heating surface in the less number of tubes will do as much work as the greater number of tubes. This may be true under certain conditions, but it is because the steam from the greater number of tubes comes from the domeless boiler wetter than that from the lesser number of tubes, and if there was provision made for drawing the steam as dry from one as the other by having a suitable dome, for instance, there is no doubt but that the greater number of tubes would do the same work with less fuel, and greater satisfaction, because the duty of the heating surface would be less, with the greater number of tubes, and the velocity of the gases less, and in consequence of the area in the greater number of tubes being more than that in the lesser number, the power required from the chimney to produce the draft would be less, and, therefore, require less heat from the furnace to produce it, and moreover the life of the heating surface and boiler would be greater, and finally it is not possible for any arrangement of dry pipes, separator or difference in number of tubes to equal the results from the dome boiler, with the greater number of tubes in any respect, under same chimney capacity and duty.

The English, Cornish, Lancashire and Galloway boilers, are generally used without domes, but are all fitted with dry pipes, to give dry steam, which is obtained from these boilers, because the steam room in them is greater pro rata to the heating surface than in any other type of boiler, and the dry pipes are long enough to draw the steam from them without raising the water, and as all these boilers are internally fired, there is greater heat next to the steam, where it should be, for maintaining the temperature of the steam, up to that due its pressure, than in the externally fired boilers, consequently these boilers give dry steam, under either nominal or great duty of heating surface.

THE APPLICATION OF DIFFERENT SIZE TUBES TO THE SAME DIAMETER OF BOILER, AND THE COMPARATIVE EFFECT IN AREA AND HEATING SURFACE.

The calorimeter or area in the tubes is of great importance to the satisfactory working of these and other tubular boilers, therefore this must be taken into account in using tubes smaller than 3 inches, for any of the size boilers given, the areas in which are in good proportion to the ribbon of heating surface in the tubes. The area in the number of tubes smaller than 3 inch, which have the same ribbon of heating surface, will be less; therefore to retain the same area as near as possible, with good proportions in number of tubes, in the same size boiler, the ribbon of heating surface should be increased, because the area to the ribbon of heating surface in a 3-inch tube is greater than in any size below it, and the larger the tube the more area it will have to its ribbon of heating surface. In comparison with 2½ inch tubes, the 48 3-inch tubes have 288 inches of area, and a ribbon of heating surface in their circumference of 432 inches. To get the 288 inches of area in 2½ inch tubes would require 67 of them, which would have a ribbon of heating surface of 495 inches; 58 2½ inch tubes have the same ribbon of heating surface as the 48 3-inch tubes, but have only 256 inches of area. Therefore, it will be seen that the area or draft opening of the tubes is of great importance in connection with the heating surface and chimney capacity. Want of knowledge or observance of these points have led many generally well-posted persons into loss and annoyance in buying boilers with small long tubes.

I know of several bad disappointments by parties buying old railroad locomotive boilers, and setting them for use as stationary boilers, and connecting them to the usual size and height of stacks or chimneys for regular stationary boilers. The number of 1¾ or 2-inch tubes in them contained a greater amount of heating surface than necessary in the ordinary boilers to do the work, but the area was so small that the fuel would hardly burn with the ordinary chimney or stack. The reason and failure is obvious from the foregoing. In conclusion, I desire to say that the object of this article is to show those who desire to use this type of boilers what proportions are best, and most likely to give the best results and satisfaction, and at the same time make a comparison of the practice in use of boilers for stationary work, in this country and in the kingdom of Great Britain and on the continent of Europe. In my own travels abroad, I never found the type of horizontal tubular boilers (so extensively used in this country) in use anywhere, at which I was greatly surprised, and asked many persons, while abroad, why they did not use them, as they cost so much less than the types of boilers they were using; and besides, they make the tubes in England of superior quality, and at much less pro rata cost, than those we make in this country. The answers were that the first cost was not the controlling consideration with them; if it could be shown that the more expensive type of boiler had the longest life and carried the greatest economy of fuel with the least cost of maintenance in order for the longest life, and that they had proven, by tests and use for a period of fifty years, that the types of boilers they were using, for the several purposes and waters, were the best and the cheapest at the greater first cost, when all things were considered. And upon investigation I found that over 80 per cent. of the several kinds of boilers in use, and under control of the several inspection and insurance companies in England, were of the internal fired kind, and principally the Cornish, Lancashire and Galloway type; and while talking with a leading manufacturer at his large engine and boiler works, near Manchester, he remarked that he knew Lancshire boilers which had been in use thirty years and had not cost eighteenpence for repairs. This boiler works have a capacity of eight of these boilers, 7 feet diameter and 28 feet long, per week; and another large works, near his, have a capacity of thirteen of these boilers per week. And within a circle of twenty miles diameter, with Manchester as a center, there are many large boiler works whose principal business is making the Lancashire type of boiler; and they all say that they must have a boiler that heats water first, and brickwork last. Now the question is: Who are right—we, with our externally fired horizontal tubular boilers, or they, with their internally fired types of flue and tubular boilers?

A builder some time since sold a small steam engine, rated at 35 horse-power. The engine did not give entire satisfaction, and the builder, feeling sure that it must be loaded beyond its rated capacity, applied the indicator, the result being that he found the load to be about 65 horse-power. The moral is: Find out the load on an engine before condemning it. Builders often find their engines condemned on very causeless grounds.

LETTERS FROM PRACTICAL MEN.

Moulding Fly-Wheels.

Editor American Machinist:

The following explanation of the method, and the direction for using all the appliances for moulding fly-wheels, as adopted by the Hartford Engine Company, are given for the purpose of assisting those who contemplate rigging up for casting fly-wheels.

The method here explained, but with a few slight changes in the appliances, is the same as that used for casting large fly-wheels in the Algers Iron Works, South Boston, 20 years ago.

My experience in this class of work leads me to believe that this method is the simplest, surest and most correct way for obtaining a uniform thickness of rim. In a fly-wheel 12 feet in diameter with a face 36 inches wide which I made by this method, I found that the unequal weights in the rim were inappreciable, and the wheel was very nearly balanced. I also remember casting a wheel 9 feet in diameter with a face 26½ inches wide, which, when cast, was so well balanced that the owner of the wheel claimed the turning of the same to be unnecessary.

By this method the hub and arms are made of dry sand cores, and the rim up to 48 inches wide is made in green sand. In moulding wheels with a 72″ face I have obtained excellent results by using loam outside and green sand inside of the rim; but yet, for wheels having faces over 48 inches wide, I consider it to be a better and easier plan to mould the inside and outside of the rim in loam, or at least loam should be used for the outside and that part inside of the rim lying underneath the arms.

The appliances used for moulding fly-wheels are illustrated in the annexed figures, in which similar letters denote the same part of the appliances. *A* represents the gudgeon or center. This center, as shown in Fig. 1, is placed in the floor sufficiently deep to give 1 inch or more clearance between the upper face of the center *A* and the lower edge *k* of the sweep *D*. The center *A* should also be placed in an exact vertical position and then firmly secured. The wings cast to this center will prevent it from turning. Place the shaft *B* into the center *A*, and on this shaft slip the sweep *D*, adjusting the latter to a suitable height for the rim of wheel. In swinging the sweep *D* around the shaft *B* its edge *k* will form a surface on which the hub core *I* is to be placed; the edge *l* will form a surface on which the arm cores *H* are to be laid, and the edge *m* will sweep a surface which is to hold the cheek and the bottom of the segment *G* of the rim pattern. After these surfaces have been formed, and the bed is well made up, the sweep *D* is removed. Now, see Fig. 2, place on the shaft *B* the arm *E* to which the segment *G* is attached. Place a flask cheek in position and ram up the outside of the rim.

When this is done, lift off the flask cheek, dress and blacken the mould. Next (see Fig. 1) slip the bottom hub core *I* over the shaft *B*, and place it in an exact central position, in which also its upper face will be even with the bank made by the edge *l* of the sweep *D*, and ram the sand firmly around it. Now place the arm cores *H* in position, with equal spaces between them, and do not allow these to strike the segment *G*. Ram up the inside; and when this is finished, dress up with blacking those ends of the arm cores which meet in the center of the wheel, and hang the same in a fire, in order to dry them. Finish the outside, black, and close on cheek. Cover rim with cores *L*, and with as many risers as desired. Slip the upper hub core over the shaft *B*; secure it in a central position, and then remove the shaft or spindle *B*. Fill the gudgeon *A* with sand, to prevent the iron from flowing into it, and set center core. See that the holes for pouring gates are all right. Lay bars on top of mould, to secure everything; cover these bars with a large plate, load it with weights, and then pour the metal.

Fig. 3 represents the covering core *L*, and is used for covering the rim, as shown in Fig. 1. It will be readily understood that by shaping the ends of this core as shown in Fig. 3, its core box can be used for any size of wheel. Fig. 4 represents a board used for holding the segment *G* in its place while ramming the inside of mould.

Fig. 5 represents a core iron, and is used in the arm core *H*. Its lugs are allowed to project beyond the core, so that the two parts of the core can be readily bolted together, which will be appreciated in moulding large wheels; for with this arrangement greater security will be obtained.

Fig. 6 represents the lower hub core, before it is placed in position.

FOUNDRYMAN.

Limiting Numbers of Gear Teeth.

Editor American Machinist:

Referring to query No. 398, AMERICAN MACHINIST, November 20, "J. F. G." will find an answer to his queries by referring to the book in which he finds the tables of which he speaks. The arc or angle of recess, etc., he will find fully explained in articles 182–194, especially in 184, 189 and 191.

His inference is correct in supposing that if a pinion will drive a wheel correctly, the latter will also drive the former, with the following difference, however. All other things being equal, there is more frictional resistance while the point of contact moves in the arc of approach than while moving in the arc of recess. This is partially explained (or asserted) in article 189. The work absorbed by friction is directly proportional to the distance of the point of contact from the pitch point, and inversely to the cosine of the obliquity, and as these both depend upon the arcs of approach and recess, it is evident that such values may be chosen as will make the friction a minimum (Article 190). The tables of limiting numbers are supposed to give such proportions as will give this result, to secure which it is necessary to give different proportions to the gears when the wheel drives than when the pinion is the driver (Articles 189, 216 and 219). The difference in the friction, however, is comparatively small, so that in ordinary practice no account is taken of any difference in the approaching and receding action.

The statement that "The arc of recess cannot be less than half the pitch" is an error. The arc of action cannot be less than the pitch and it ought never to be less than 1⅛ times the pitch. The sum of the arcs of approach and recess is equal to the arc of action, and if the recess is less than half the pitch it is simply necessary to make the approach greater than half the pitch to obtain the required arc of action. Of course this may not give the most economic result, but it does not prevent either wheel or pinion to be taken as the driver, as the book clearly teaches.

S. A. COLUMBUS.

November 19, 1886.

How to "Back Off" Taps.

Editor American Machinist:

In the AMERICAN MACHINIST of November 16, W. A. G. asks how screw taps may be backed off in a lathe. Any screw-cutting lathe may be easily arranged to do this job very nicely by giving the tool carrier a slight

Fig. 2

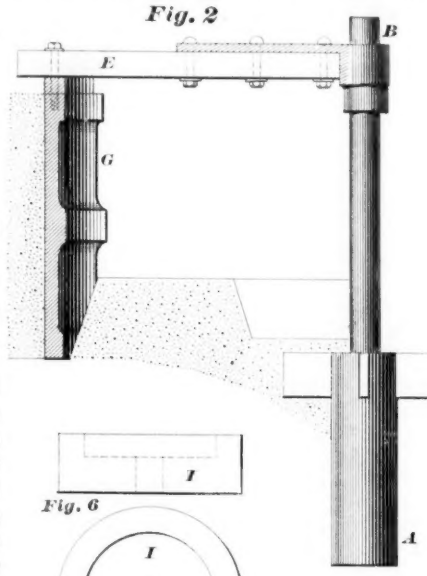


Fig. 6

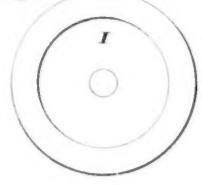
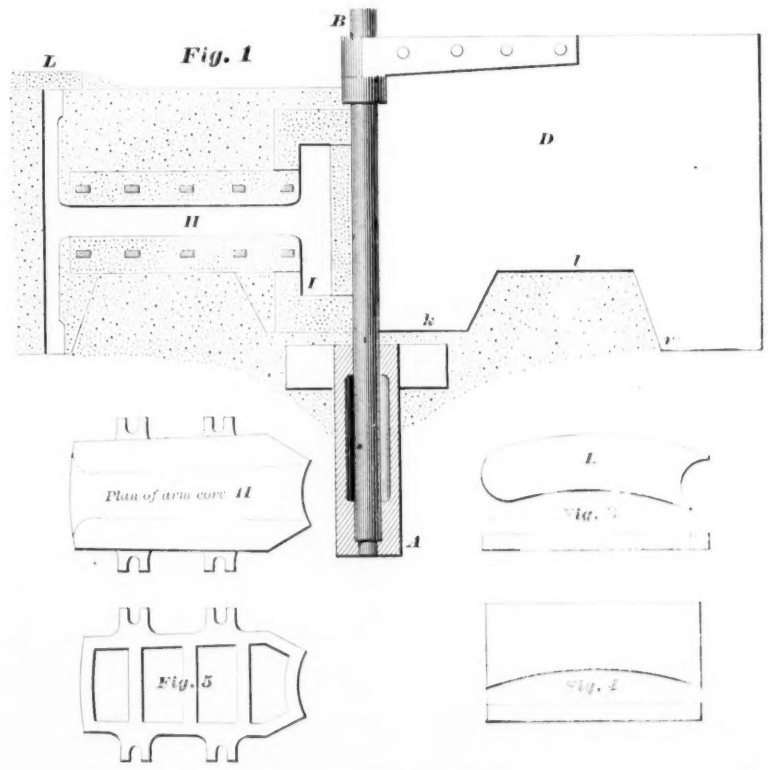


Fig. 1



MOULDING FLY WHEELS.

slight, and the impulse must be given several times at each revolution of the tap, according to the number of sets of teeth the tap is to have, whether four sets or more, according to size of tap. The handle of the cross feed screw may be removed when this device is in use, to give freedom to the carriage. Run the lathe slowly.

F. G. WOODWARD.

To Make Pipes in Loam Without a Pattern.

Editor American Machinist:

We must have something to work from, so we get a skeleton of a pattern the same thickness as the casting is to be, parted in the middle the same as any other pipe pattern. About all that is required is one ring at each opening, with strips cut the same shape as the pipe and fastened together; that is, a top part and bottom part. Brace it firm so that you can handle it without breaking. We will say, for instance, that this is a 36-inch pipe; that is, 36 inches, with branches on the sides, say 12 inches or 18 inches—it don't matter.

Get your bottom plate down and put a layer of brick on the spicket end; you can lay two more bricks, as that will make it about level when the pattern is on. Now put a little loam on, and then lay your pattern on, and level it and prop it up to its place; get your brick, and lay them to within ¾ of an inch of the pattern up to the joint, leaving the ends or prints open.

In making pipes in this way, it needs several strikes of different shapes and sizes to strike out between the ribs and around the angle to the branches. Great care must be taken when sweeping them out, as it is liable to be 2 inches thick in one place and no thickness in another.

In a pipe of this size there are generally strengthening strips put up around the body of the pipe; so, if these are put on the skeleton, it will make it all the stronger, and give a better guide to strike out by. Now get your loam and put it on the brick, rubbing it in well; get your strike and cut it out to the level of the bottom of the pattern or skeleton. After you have finished that, put a little parting sand on it and put in your thickness, striking it off from the top of ribs. You can now get your rags or paper or parting sand, and put it on, and then you are ready for the core.

The core bar should be strong; the main center bar about 4″ x 8″, with wings extending to ¾ of an inch of the pattern. This is not a full bar, but a half section cast open or, if it is covered, a rib on top of th main bar would strengthen it considerably. For your core riddle a lot of core sand on the floor, and put it in the mould about an inch thick; then put in the bar, knock it down to the level of the joint, put in your sand and ram it up. If you have 5 or 6 inches of core sand next the pattern, any other sand will do for the middle. When it is rammed up to the joint, vent it well all over, and then put some small coke or cinders over it.

I am going a little too fast; before loaming up the bottom part, the top part of the skeleton might be lifted off, to give more room to work.

Now put on more sand and ram it up as near as you can to the shape without extra pains and vent it all over again, and stop up the vents on top. Take the top part of the skeleton and put it back again and ram it up to the top of the ribs, sleek it and make your parting.

The middle ring for this pipe should be gaggered on the bottom so that it will lift the loam. Put a good layer of parting sand on the joint and about 1½ inches of loam. Clay-wash the ring and put it on, knock it down till you think the gaggers are near the joint, put your loam on the core and brick up square on the outside; one brick above the top is sufficient, then get a lot of soft mud and spread it over the top as even as you can and as quickly, or it will set before you can get your top plate on; sledge it down well, and if you can get a vent wire between the plate and the bricks it will be all the better, as it will give it a chance to dry quicker.

Lift off the top part and block it up on

the carriage. If the oven is large enough to dry them altogether, it is better to put the bottom side by side and the core on top, as it will take more heat to dry the core than the other parts.

Now back to the core; strike out the thickness to the bottom of the ribs and then take the top part of the skeleton off, and finish the core as far as you can, then lift it out and finish it and place it on the top of the other on the carriage. Strike out the thickness on the lower part, take out the pattern, and dress it up, put it on the carriage, finish the top part, put it in the oven for about three days, and it will be ready for casting.

The best way that we have found to cast this kind of a pipe, is to put one runner or gate stick on each side of the print, on the spicket end, and one on top of the print, so that when it is being poured the center hole will have a plug in it that must be drawn out when the casting is about two-thirds full, as that runs along the top of the core, and enlivens up the iron.

THOMAS WATHEY.

Cleveland, Ohio.

Benefit of a Dome on a Tubular Boiler.

Editor American Machinist:

In No. 49 I notice an article by Mr. William Lowe on the danger and expense of using tubular boilers without domes, which cannot fail to excite the surprise of parties using that type of boiler with the highest economy and satisfaction. On the point made, that the steam from a domeless boiler is always wet, and that a test showing a high evaporation is simply a large amount of water carried over with the steam not evaporated, would like to take some figures from *Van Nostrand's Engineering Magazine* of February, 1884, from a test made by Mr. J. W. Hill on six return tubular boilers, shells 6×16 feet, built by the Whittier Machine Company. The evaporation "from and at 212°" was 13.293 Calorimeter experiments showed a percentage of moisture in steam of 2.21. How much could this have been improved by the addition of a dome? One point that is sometimes lost sight of is the mistaken idea of many intrusted with the care of boilers, that the more water you have the less danger from a disastrous explosion, and water is kept nearly to the top of the boiler. With such an attendant a dome would improve the quality of the steam.

Wet steam in the engine does not always indicate that the trouble is with the boiler, as in some cases it proceeds from a large number of bends and tortuous passages of the steam pipe, or an insufficient covering of the same.

This question of domes is important, as in how many cases do we read in accounts of boiler explosions that the initial fracture was somewhere in the joint where the dome was attached to the shell: Is a smash-up on the engine as bad as a smash-up on the boiler?

So far as the dome being a reservoir for steam is concerned, if a dome were arranged so that its connection with the boiler could be shut off it would be seen that the pressure would drop instantly, as the only reservoir possible in a boiler is in the water, as this has the power of enormous expansion, while steam must constantly lose.

Waterbury, Conn. W. E. CRANE.

Graphical Method of Finding the Mean Effective Pressure of Indicator Diagrams.

Editor American Machinist:

When the area of an indicator card has been found, the mean effective pressure may be readily ascertained by a graphic method, and the labor of computing it be avoided. In Fig. 1, the line A B is the atmospheric line. With the point B for a center draw a circular arc, with a radius, in all cases, of exactly one inch. From A draw a line A G, which is tangent to the arc just drawn. Say, for example, that the area of the card is 2.71 square inches. Upon the line A G lay off A C equal to 2.71 lineal inches. Now C H measured by the pressure scale of the card equals the mean effective pressure. The result is correct for any length of card.

The geometric demonstration of this method is shown in Fig. 2. Draw B D parallel and equal to A C. Now the parallelogram A C B D has a base A C of 2.71 inches and a height B K of one inch, consequently its area is 2.71 square inches, the same as that of the card. The parallelogram A B C D and the rectangle A B E F are equal, because they stand on the same base A B, and are of the same height. Thus the rectangle A B E F has the same area as the card, and its height A E or C H indicates the mean effective pressure.

In the case of a card taken from a condensing engine, the line A B must be the line of absolute vacuum.

No care need be taken to secure cards of any given length, for by this method cards of all lengths are readily comparable.

C. W. PARSONS.

Why a Pump Failed to Work.

In your issue of Nov. 13 Mr. Durfee's trouble with a safety valve reminds me of a case I had some years ago, when I was just beginning to run. It was with an old-fashioned crosshead pump. It worked all right when I stopped for dinner, but when I attempted to start, it would work through the overflow, but upon turning it into the boiler it would not go; it blew all the gaskets out. I put in new gaskets, and it was the same. We would pull the fires, let the steam down, fill the boiler, and try it again; each time taking the pump apart and examining thoroughly for lime in feed-pipe, valve stuck or something wrong, but could find nothing. In the meantime we had got all the best engineers in the vicinity, including one chief of a line of lakes steamers; but none could find the trouble, and all went away without saying much. Three days passed in this way, and no nearer a solution than at first. On the morning of the fourth day I went to the mill before breakfast, and started my steam, and then went for the pump, when, on putting my hand down through the upper valve seat to feel the lower valve, my hand stuck, and trying to get it out, out came the seat. The seat was of brass, fitted in a cast-iron chamber. I put that seat back, with a small piece of cloth around it, and drove it home, started, and the pump worked like new. The trouble was in the seat raising and holding the water in the chamber, so that the packing had to give way. You may think I told all those old heads what was the matter, but I didn't. If they ever know it, they will have to see this. The unexpected often happens. J. A. C.

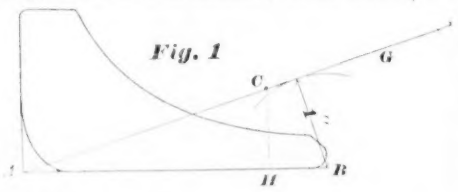


Fig. 1

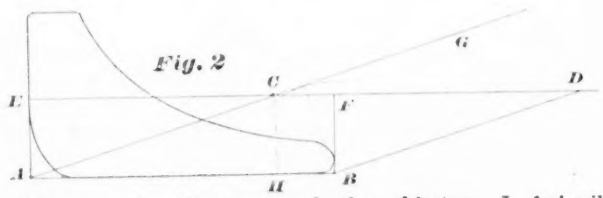


Fig. 2

Information About Blue Prints Wanted.

Editor American Machinist:

Since the first process for the making of blue prints was generally known, I have been using it, but have never been satisfied with the results as compared with prints I frequently see that are made in the North. It strikes me that we are behind in the improvements in this line.

If you will induce some of the experts in this line to give us an article in the AMERICAN MACHINIST, giving clear and full instructions on the following points, it will greatly oblige such of us who desire to (but don't) make clear blue prints:

1st. The best sensitizing solution.
2d. The best paper for the purpose.
3d. The best way to prepare the paper.
4th The best way to wash the paper.
5th. How long after the paper is prepared should it be used to get the best results.
6th. If a drawing be made on transparent paper, what kind is best?
7th. If a tracing is made, is tracing cloth or some kind of transparent paper best?
8th. How to know by the color when a print has been sufficiently exposed, and any other information necessary to a clear understanding of the process.

I have some blue prints (made in Cleveland, Ohio,) on which are shown several sunk panels, the edges of which are of a much lighter and different tint of blue. How is it done? C. H. PICKERING.

Getting Oil Out of a Grindstone.

Editor American Machinist:

"A Correspondent" can get the oil out of his grindstone, if he will mix a pail of whiting and water to the consistence of thick cream. Move the grindstone near the stove, or where it can be made and kept as hot as its safety will allow. Give it a thick coat of whiting, by spattering it on with a brush. It will soon get saturated with the oil. Then scrape it off, and repeat until it is all extracted. WILLIAM NEWTON.

Oneonta, N. Y.

The Feed Water Question.

Editor American Machinist:

I think it is time I said something more on the feed-water question before the subject is forgotten. I have waited in the hopes of hearing from some of the advocates of the side I was trying to defend, but as there is nothing said, I conclude there are no believers in that side of the question among your readers, which I consider a compliment to the AMERICAN MACHINIST.

The fact is, the objections your correspondents raised to my argument are unanswerable, and I think I made as strong a point as I could. Your space is too limited to go into the beautiful laws of thermodynamics, but as I acknowledge defeat, and as no one has answered the objectors, I feel willing to see the feed-water fellows brought to task hereafter without feeling that they have not had fair play.

While I am on the subject let me mention a case in which there is a bare chance of heating feed-water above 212° without back pressure. It is a corollary of the fundamental law of thermodynamics that if there is no work done there is no heat lost. I believe Joule tried a beautiful experiment to illustrate this. Two copper vessels were connected by a stop cock; one had the air exhausted from it, and the other was filled with compressed air. They were both immersed in water and the temperature taken accurately, then the stop cock was opened and the air allowed to pass from one vessel to the other. There was no change in the temperature of the water, the heat lost in starting the air on its course being all regained in friction and reaction of stopping. Now, if an engine takes dry steam for a full stroke and exhausts at the end of the stroke in expanding from say 40l bs. to 15 lbs., there is no heat lost, as there was no work done, or if lost by the work of starting the column of steam through the ports it is again regained by the friction on the sides of the ports and reaction on the exhaust column as in Joule's experiment.

The gas issuing freely from a gas well is cold, but we must not lose sight of the fact that it has work to do in lifting a column of air at atmospheric pressure, and also that some of the heat is regained by the commotion in the air.

I wish to thank your correspondents for their free criticism of my pseudo arguments. JOHN COFFIN.

Lacquer for Brass.

Editor American Machinist:

In answer to inquiry of No. 413 in Nov. 27th issue, of T. W., in regard to keeping polished brass from tarnishing, lacquer it. The lacquer is cheap, and can be procured at any paint store, or from any manufacturer of brass goods, such as bird cages, chandeliers, or gas fittings. E. E. J.

Patternmakers' Tools.

Editor American Machinist:

I was somewhat amused at the question put by friend Barrows in yours of Oct. 30, in relation to the location of pattern shops on the top floors of shop buildings. It may be according to the eternal fitness of things, or it may be one of those things that "no fellow can find out," but I would like to ask another question in relation to the same business. Why is it that in so many shops where the latest improved tools are obtained for machine shop use, the tools, such as lathes, saws, etc., provided for the patternmakers are either few in number or of such an antiquated and makeshift style as to cause disgust instead of pleasure to those who are required to do good work on them?

I occasionally visit this city and take great interest in visiting the various shops and noting their peculiarities. In most of the shops here the pattern shops are located on the ground floor, with good light and pretty well supplied with machine tools. I visited one, however, which was located on the floor above the machine shop with the result of making it very cool and comfortable for the lathemen below, but quite otherwise for the patternmakers; the floor being light was in constant vibration from the shafts hung below it, reminding one somewhat of a ride on an old-fashioned buckboard.

I could not help noticing the difference in the results from band saws in two other shops. In one the saw appeared to be in excellent order, the work being smooth enough with scarcely any dressing, while with the other there appeared to have been an odd tooth left that made a fearful score in the work at every round of the band. I presume it was what might be called a hunting tooth.

It seems strange that wood lathes for either face or center work should so rarely be equipped with a slide rest when the advantages are considered. Several years ago I had the chance of building up some rings in segments on a lathe so rigged in a cabinet shop for turning table tops, with such a gain in time that I have wished for something of the sort whenever I have had similar work to do; the same is true in turning long columns for building or other purposes.

I find some shops fully supplied with small tools, such as iron and wood clamps, plenty of chucks for the lathes, good vises, etc., while others are very poorly supplied and still expect work done as well and as quickly as the others, which is, to say the least, unreasonable.

I think some of the poor arrangements for pattern shops arise from the fact that patternmaking as a rule is regarded as an expense without a return; as a sort of necessary evil which has to be got over with as little expense as possible, and yet to be a competent patternmaker requires a higher order of intelligence and greater application and study than to reach the corresponding grade in any other mechanical branch of the business, without any correspondingly increased compensation.

I think, however, that those proprietors who furnish the most comfortable shops and the most complete and best maintained outfit of tools, must find their return in the reduced expenses of the patternmaking department, and in the greater accuracy of the work produced, as a man who is worn down with severe muscular exertion is not always in the best possible condition for exerting his brain power in laying out, or for putting on that fine and exact work that is required on some machine patterns.

I am aware that from the nature of pattern work, there being little or no duplication in the work, there is a difficulty in using machine tools to the best advantage, but it is nevertheless a fact that with the tools referred to by Mr. Barrows, if procured from the best makers who have made a study of the special duty for which such tools are re

quired, a saving is the result, of such an amount as would be incredible to those who have been jogging along in the old-fashioned style. W. J. S.

Denver, Col.

Using a Small Planer for Large Work.

Editor American Machinist:

Some time since I read an account in the AMERICAN MACHINIST of a plan for leveling up a cylinder on a planer, for the purpose of planing or milling the valve seat, as the planer was too small for the purpose. I can tell the writer how to do the next job of that kind: Make an angle plate to bolt on the back end of planer table; then take the slide and tool holder off the housings and bolt to angle plate. He can then readily attach a rod feed, depending upon the make of the planer.

Now take two bars of flat iron, 1″x3″, and twice the length of planer. Raise the planer up a little, and put the irons under the legs, leaving the extra length extending out on the end of planer, to which the angle iron is attached.

The extended ends of irons under legs should have holes drilled in them for bolts to bolt the cylinder down to. Level up the cylinder by planer bed, bolt it fast, and go on with the planing.

The cylinder can be bolted to the legs of planer, if desired, by a long bolt through the base.

HARLAN WELLMAN.

Casting Aluminum Bronze and other Strong Metals.

BY THOMAS D. WEST, CLEVELAND.

A PAPER READ BEFORE THE NEW YORK MEETING OF MECHANICAL ENGINEERS.

The ability to cast in moulds a material which possesses strength equal to the best forgings of wrought iron and steel, is an achievement which mechanical engineers may well be interested in. While it is true that the strongest metals are susceptible of being cast, yet there are peculiarities about them which cause greater inconvenience and expense in the effort to procure good, solid, clean castings than occur with cast-iron. These come mainly from the difficulties in overcoming the evils due to oxidation, shrinkage and contraction. These elements, of course, exist in the founding of cast-iron; but the degree to which they make labor and trouble is very slight as compared with stronger metals. The list of these latter is now enlarged by that comparatively new metal "aluminum bronze," and the experience of the writer is here to be cited in his endeavors to establish principles and methods for its successful moulding and casting in the foundry of Cowles Electric Smelting Company, the firm manufacturing this bronze and other alloys of aluminum, at Lockport, N. Y. It is hoped, also, that ideas may be presented which may, in many cases, prove of value for the making of castings from other metals.

The difficulties which beset the casting of aluminum bronze are, in some respects, similar to those which were encountered in perfecting methods for casting steel. There is much small work which can be successfully cast by methods used in the ordinary moulding of cast-iron; but in peculiarly proportioned, and in large bronze castings, other means and extra display of skill and judgment will be generally required. In strong metals there appears to be a "red shortness" or degree of temperature, after it becomes solidified, at which it may be torn apart, if it meets a very little resistance to its contraction, and the separation may be such as cannot be detected by the eye, but will be made known only when pressure is put upon the casting. To overcome this evil, and to make allowances for sufficient freedom in contraction, much judgment will often be required, and different modes must be adopted to suit varying conditions. One factor often met with is that of the incompressibility of cores or parts forming the interior portion of castings, while another is the resistance which flanges, etc., upon an exterior surface, oppose to freedom of contraction of the mass. An illustrative case, which the writer had to deal with in the foundry referred to above, was the casting of some blast-fuanace tuyeres, the dimensions of which were about twelve inches diameter at the small end, and fourteen inches diameter at the large, and seventeen inches long. These tuyeres were made hollow for the passage of water to keep them cool when the furnace was in blast. The core to form this hollow space was one which foundrymen would term a "mean core" to make and to use, and the stronger it could be made by means of the mixture of the sand, the easier would it be to make and to handle. But it was proved at the hydraulic testing of the first casting that these conditions were the worst for causing leakage. It was found that in order to procure a casting which would not leak, the core must be "rotten" and of a yielding character. This was obtained by using rosin in coarse sand and filling the core as full of cinders and large vent-holes as possible, and by not using any core-rods or irons. The rosin would cause the core, when heated, to become soft, and would make it very nearly as compressible as a "green sand" core, when the pressure of the contraction of the metal would come upon it. It might be well to state that the size of this core was such as would leave one inch thickness at each end, and one quarter inch at the inner and outer sides of the casting, and was all surrounded with metal, excepting four one inch round openings through which the core delivered its vent or gas. By means of dried rosin or green-sand cores we were able to meet almost any difficulties which might arise in ordinary work from the evils of contraction, so far as cores were concerned. For large cylinders or castings which might require large round cores which could be "swept," a hay-rope wound around a core barrel would often prove an excellent yielding backing, and allow freedom for contraction sufficient to insure no rents or invisible strain in the body of the casting. To provide means for freedom in the contraction of exterior portions of castings which may be supposed to offer resistance sufficient to cause an injury, different methods will have to be employed in almost every new form of such patterns. It may be that conditions will permit the mould to be of a sufficient yielding character, and again it may be necessary to dig away portions of the mould, or loosen bolts, etc., as soon as the liquid metal is thought to have solidified. In any metal there may be invisible rents or strains left in a casting through tension when cooling sufficient to make it fragile or to crack of its own accord, and it is an element which, from its very deceptive nature, should command the closest attention of all interested in the construction of castings.

Like contraction, the element of shrinkage is one often found seriously to impede the attaining of perfect castings from strong metals. In steel castings much labor has to be expended in providing risers sufficient to "feed solid" or prevent "draw-holes" from being formed, and in casting aluminum bronze a similar necessity is found. The only way to insure against the evils of shrinkage in this metal with work requiring "risers" or "feeding heads" was to have them larger than the body or part of the casting which they were intended to "feed." The "feeder" or "riser" being the largest body, it will, of course, remain fluid longer than the casting, and as, in cast iron, that part which solidifies first will draw from the nearest uppermost fluid body, and thus leave holes in the part which remains longest fluid. The above principle will be seen to be effective in obtaining the end sought. It is to be remembered that it is not practical to "churn" this bronze, as is done with cast-iron. A long cast-iron roll, one foot in diameter, can by means of a "feeder" five inches in diameter and a half-inch wrought-iron rod, be made perfectly sound for its full length. To cast such a solid in bronze the feeding head should be at least as large as the diameter of the roll, and in length about one-quarter longer than the length of roll desired. The extra length would contain the shrinkage hole, and when cut off a solid casting would be left. This is a plan often practiced in the making of guns, etc., in cast-iron, and is done partly to insure against the inability of many moulders to "feed" solid, and to save that labor. There is nothing in the way to prevent obtaining large guns of aluminum bronze as perfect as are made of cast-iron. It is simply a question of having enough "riser" or "feeding head," and such guns would surpass in strength any other metal now used in their manufacture.

A method which the writer found to work well in assisting to avoid shrinkage in ordinary castings in aluminum bronze, was to "gate" a mould so that it could be filled or poured as quickly as possible, and to have the metal as dull as it would flow, to warrant a full-run clean casting. By this plan very disproportionate castings were made without "feeders" on the heavier parts, and upon which "draw" or shrinkage holes would surely have appeared, had the metal been poured "hot."

The plan or principle adopted in pouring this bronze, is similar to that employed for casting steel, which, as is well known, consists in pouring through a spout controlled by a valve, which lets the metal flow from the bottom of a ladle instead of the top or lip, as practiced in pouring cast iron. The exact plan which the writer used for castings weighing over fifty pounds, was to make the pouring basin sufficiently large to contain all the metal necessary to fill the mould, and give any surplus which might be required for a "flow-off," or to fill up "feeding heads," etc., and so prevent any metal from flowing into the mould until it was all in the pouring basin. The entrance of the gate would be stopped by means of an iron plug, and the moment all was ready, it would be pulled, and the metal would almost instantly fill the mould, so large would its gates be made. By such a plan it will of course be readily seen that there was no danger of any "scum" or oxide entering the mould, an element which would seriously mar the appearance of a casting. Besides the difficulties from difference in the color which resembles gold, such oxide would be very liable to cause a disunion of the particles of the body, or make an unacceptable surface when the casting was finished up. The metal itself is one that works well in our ordinary moulding sands, and "peels" extra well. As a general thing, disproportionate castings weighing over one hundred pounds, are best made in "dry" instead of "green" sand moulds, as such will permit of cleaner work and a duller pouring of the metal, for in this method there is not that dampness which is given off from green sand mould, and which is so liable to cause "cold shuts." When the position of casting work will permit, many forms which are proportionate in thickness can be well made in green sand by coating the surface of the moulds and gates with silver, lead or plumbago. Information upon manufacturing, strength and melting of aluminum bronze, can be found in an article from the writer published elsewhere.*

From "blow holes," which are another characteristic element likely to exist in strong metals, it can be said that aluminum bronze is free. Should any exist it is the fault of the moulder or his mould, as the metal itself runs in iron moulds as sound and close as gold. Sand moulds to procure good work must be well vented, and if of "dry sand," thoroughly open sand mixture should be used and well dried. The sand for "green sand" work is best fine, similar to what will work well for brass castings. For "dry sand" work the mixture should be as open in nature as possible, and for blacking the mould, use the same mixtures as are found to work well with cast-iron.

The different problems of making strong metal castings all present peculiarities which call for special treatment in the manner of moulding, etc., but, as said in the beginning of this paper, the difficulties to be overcome mainly hinge more or less upon one or other of the three elements, oxidation, shrinkage, or contraction. These are being controlled better every day, and progress is made by which almost any kind of casting can be procured as readily as of cast-iron. With aluminum bronze, "Mitis," and steel castings to be had, the engineer should not want for strong metals to meet almost any conditions which he may desire.

* In the AMERICAN MACHINIST, Oct. 26, 1886.

The Sewer Strike in Stamford.

Some of our friends in Stamford, Conn., inform us that we did not get the facts in regard to a strike of Italian laborers employed in constructing a sewer in that borough. We gathered some of the particulars published in the daily papers, and used them merely by way of illustration in an editorial. The facts were as follows: The job was carefully let to competent parties, the borough keeping back a liberal percentage to guard against possible loss. These contractors sublet part of the work. The sub-contractor got a good price, but went to work by antiquated methods to do the job, and finally absconded in debt, some of it being to the Italian operatives. The Italians did not clearly understand why the borough should not pay them, as it had the benefit of the completed work, and they are ignorant in such matters. But they did not threaten dynamite or anything of the kind. On the contrary they behaved very well indeed. Their threat to dig up the pipe was made more laughingly than otherwise. Finally the original contractors said that while they were under no legal obligations to pay the debts of the absconder, they felt under some moral obligations to do so, and did pay them. In the contract it was distinctly specified that home labor should be given preference, and home men were employed until, other work being plenty and that kind of work rather disagreeable, they gradually left for other work, and Italians had to be hired. The Italians were first paid $1.30 and finally struck and got $1.50; these are considered good wages for laborera at Stamford.

Progress in Boards of Trade.

Most large cities and many smaller ones have Boards of Trade or Chambers of Commerce. These associations have been mainly useful to their members as affording headquarters for obtaining market reports and making contracts for wholesale business. Their rooms are simple business exchanges. The public hear from them most as pressing some measure or appropriation for legislative action. Recently, however, there are evidences of advancement in some of the oldest organized institutions of this kind.

They evidently have observed some of the commercial and manufacturing benefits a few of the newer organizations have conferred upon the cities whose business, as a whole, they are believed to represent.

There is a noticeable tendency to sink selfishness in public spirit of the kind that does not limit itself to petitioning Congress or the Legislature to do something for trade and commerce. As an instance, the Board of Trade of Paterson, N. J., has declared in favor of arbitrating differences between capital and labor, and proposes a conference on the subject in which both sides shall be fairly represented.

Paterson has been greatly troubled with strikes in silk works, locomotive shops and other industrial establishments, and if the plan of arbitration can be carried out fairly, as suggested, these troubles are likely to be much less in the future. No doubt the Board of Trade by earnest action can prevent the recurrence of most labor difficulties in Paterson. The offer of conciliation goes far towards maintaining peaceful labor relations in an industrial community. Assuming a policy of haughtiness and disdain to recognize labor unions has directly the opposite effect. The fact must be admitted that labor organizations are as firmly established as Boards of Trade and Chambers of Commerce. Arbitration is seldom refused when offered in the right spirit. Those commercial bodies cannot only aid in promoting manufacturing and other industries in cities, but can do much to prevent strikes, lock-outs and labor troubles.

AMERICAN MACHINIST

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

HORACE B. MILLER, Pres't.
JACKSON BAILEY, Vice-Pres't.
LYCURGUS B. MOORE, Treas. and Sec'y.
96 Fulton Street, New York.

JACKSON BAILEY, Editor. HORACE B. MILLER, Business Manager.

F. F. HEMENWAY, Mechanical Engineer.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 BOUVERIE STREET, Fleet Street, LONDON, ENG., will receive subscriptions for the AMERICAN MACHINIST, at 14/7 per annum, postage paid.

DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.

SUBSCRIPTION.

$2.50 a year in advance, postage prepaid in the United States and Canada.
$3.50 a year to Foreign Countries, postage prepaid.

ADVERTISING.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

EDITORIAL ANNOUNCEMENTS.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

NEW YORK, DECEMBER 18, 1886.

CONTENTS.

	PAGE
Double Spindle Variety Moulder	1
Medart's Straightening Machine	1, 2
Practical Drawing. By J. G. A. Meyer	2
The New York Meeting of the Mechanical Engineers	2, 3
Railroad Shop Notes	3
A Generous Gift that Should be Appreciated	3
Moulding Pulleys. By Robert E. Masters	4
Return Tubular Boilers. By William Lowe	4
Letters from Practical Men — Moulding Fly Wheels. By Foundryman — Limiting Numbers of Gear Teeth. By S. A. Columbus—How to "Back Off" Taps. By F. G. Woodward—To Make Pipes in Loam Without a Pattern. By Thomas Wathey—Benefit of a Dome on a Tubular Boiler. By W. E. Crane—Graphical Method of Finding the Mean Effective Pressure of Indicator Diagrams. By C. W. Parsons—Information About Blue Prints Wanted. By C. H. Pickering—Getting Oil Out of a Grindstone. By William Newton—The Feed Water Question. By John Coffin—Lacquer for Brass. By E. E. J.—Patternmakers' Tools. By W. J. S.—Using a Small Planer for Large Work. By Harlan Wellman	5,6,7
Casting Aluminum Bronze and Other Metals. By Thomas D. West	7
The Sewer Strike in Stamford	7
Progress in Boards of Trade	7
The Seventh Annual Meeting of the American Society of Mechanical Engineers	8
Labor Warfare that Reacts	8
Questions and Answers	8
Business Specials	
Manufactures	9
Machinists' Supplies and Iron	19

The Seventh Annual Meeting of the American Society of Mechanical Engineers.

The seventh annual meeting—the fourteenth regular meeting—of the mechanical engineers was held in New York, beginning Monday evening, Nov. 29, and closing on Friday of the same week. There was altogether an attendance of about 200, and the interest in the sessions was well sustained. It is not possible in a city like New York to get all the members at any single meeting; many come to combine business with pleasure, and as the society was in session till, substantially, the close of the week, members naturally selected their own times for business outside that of the society. Nevertheless the attendance was very good in point of numbers.

There were elected to membership 41 members, two associates and 3 juniors, which gives the society a total membership of 736—a good number for the comparatively short time the society has been in existence.

The Council's report contained some suggestions as to future government, the chief one of which was that the names of members suspended after one year for non-payment of dues be retained on the books for two years, during which time they may be reinstated after full payment of arrears. After that time, should they desire to re-enter the society they must come in as new members. This course appears to be a wise one, and one the society in its present standing can well afford to take. There may be valid reasons for a member getting in arrears for one or even two years—reasons for which it would not be wise to force him out of membership.

The Finance Committee's report showed a balance on hand, but not so large as desirable. The transactions of the society for the year past have been large, and the expenses for printing have accordingly been unusually heavy. It is hardly probable that this expense will be materially less in the future; on the contrary, the presumption is that it will be greater, from year to year, rather than less, and of course will have to be met. Increased membership makes the society better able to do this; there is not likely to be any trouble on this score.

The Library Committee reported a gratifying increase in the library fund. A good many members stand pledged to a yearly contribution towards this fund, which gives it a permanent character. There have been several contributions of books, and the number in the library is already respectable. Quite a large number of technical and scientific journals and publications are received regularly at the Secretary's rooms, and many complete or nearly complete volumes of such publications are possessed by the society.

The society has been fortunate so far in the selection of officers who have zealously worked for its best interests, and those who have been wisely selected for the coming year, and whose names we give elsewhere, will prove no exception. Altogether, considering the growth and the interest of its members, the American Society of Mechanical Engineers appears to have entered upon an era of prosperity and much usefulness.

The local committee, together with Secretary Hutton and his assistant, made excellent arrangements for the sessions and for the excursions, and are entitled to much credit for doing this by no means easy task remarkably well. A letter was received from President Coleman Sellers, who is abroad, regretting that he was prevented from being present at the meeting. As is well known Mr. Sellers is detained by sickness. Much individual regret at his absence, and especially from this cause, was expressed.

Elsewhere we devote considerable space to the papers read at, and the proceedings of, the meeting.

We deeply regret to hear of the decease of William Woodcock, master mechanic of the Central Railroad of New Jersey and president of the American Railway Master Mechanics' Association. This sad event occurred at his residence in Elizabethport, N. J., on the 27th of November. Mr. Woodcock was a native of England, and came to this country when a boy. He was a self-made man. Through industry and study he became a recognized authority on all matters relating to locomotive and car building and general railroad construction, and the railroad company whom he so faithfully served, recognize the loss of a valuable employe, whose place cannot be easily filled. All who knew him mourn the loss of one of their truest friends; and the city in which he lived has lost one of its best and most prominent citizens.

Labor Warfare that Reacts.

Items of news are becoming frequent, mentioning certain firms and companies that have served notice upon their employes that they will hire no men who belong to a labor union unless he will first sign a paper renouncing his union, and giving up his liberty to join another. Several of the establishments mentioned are shoe manufacturers, and it is usually said that no trouble is found in filling the shops with non-union workmen. While this is probably true, it should be well understood that it is just as essential to sell goods as to make them, and that it does not help any business to antagonize a large portion of possible customers.

Working men and women (we will not use the hackneyed and obnoxious expression, "the working classes") buy shoes and most other products of industry, and the manufacturer of any articles they are expected to buy, who declares war upon trade unions, thereby shows that he does not yet comprehend the A B C of the labor union movement. If he had got well through the primer and fairly into the first reader of the movement he would know that not only are labor organizations throughout the country linked together for mutual protection, but that the masses of people sympathize with them when on the defensive against injustice. To the man whom fortune has made an employer of others, and who hesitates not to use his power to oppress those who serve him to obtain their daily bread, any mention of this fact is distasteful, but nevertheless it is a fact that no sophistry can conceal. Fortunately there are comparatively few such employers, and fortunately the daily news gatherers keep the public informed where they are.

Those who denounce (and it deserves denouncing) the policy of ostracising a workman because he refuses to join a union, and taking measures to prevent his obtaining employment, cannot consistently approve of ostracising workmen because they do belong to unions. We do not believe the labor question will ever be even approximately settled until such warfare shall be made obsolete.

The idea that there is to be unhealthy competition in manufacturing as between the North and South on account of cheaper and more tractable labor in the latter section of the country is fast being dispelled by the logic of events. The negro is found to be an apt scholar in the way of combination, and understands the mysteries of strikes and lock-outs by intuition.

The new one dollar silver certificates are not very plentiful yet, but we have begun to receive them from England for the payment of subscriptions.

Mr. Dyer, at the recent meeting of the Philosophical Society of Glasgow, presented a paper on the "Development of the Marine Engine." The author said that while in 1863 the coal required was more than 4 pounds per horse-power, it was now as little as 1¼ pounds, or even slightly less. He feared, however, that this was not all gain, as some of the economy of recent improvements might be neutralized in overcoming increased friction.

The Northwest Magazine, of St. Paul, in its November number gives illustrations and descriptions of the works of the Warner & Hough Machine Company, and the Holland & Thompson Manufacturing Company, two of the four establishments attracted to that city by an article in the AMERICAN MACHINIST last March.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(426) Will a tool revolving around the work cut easier than a stationary tool, the work revolving? *A.*—Other things being equal, we do not think there will be any difference.

(427) J. C., Syracuse, N. Y., writes: 1. Will you please inform me which of the eccentrics on a locomotive is the forward eccentric when the engine is going forward? Is it the eccentric which is connected to the top of the link, or the one connected to the bottom of the link? *A.*—In locomotives which have the eccentrics placed on the main driving axle, as in the regular American type, the eccentrics connected to the top of the link are the forward eccentrics. In locomotives which have not the eccentrics placed on the main driving axle, the eccentrics connected to the bottom of the link are generally the forward eccentrics. 2. Why are these eccentrics called the forward eccentrics? *A.*—See Modern Locomotive Construction, twenty-seventh paper, Oct. 2d, 1886.

(428) F. E. writes: Will you please give me a rule for obtaining the chordal length of a section of a fly-wheel? I want to get the exact length across ⅛th segment of a 20 foot fly-wheel. *A.*—Find the number of degrees in the angle formed by the two radii drawn from the extremities of the chord. Multiply the sine of one-half this angle by the diameter of the fly-wheel; the product will be the length of the chord required. Thus: Since the segment is ⅛th of the fly-wheel, the number of degrees of the angle formed by the two radii, drawn from extremities of the chord, must be ⅛th of 360 degrees, which is equal to 45 degrees. One-half of 45 degrees is 22° 30'; the sine of an angle of 22° 30' = 0.3826; and 0.3826 × 20 feet = 7.652 feet, which is the length of the chord required.

(429) Constant Reader, Milbury, Mass., asks: 1. How can I make a simple hygrometer? *A.*—We know of nothing more simple than the wet and dry bulb thermometer. One thermometer is used naturally, and the bulb of the other is covered with muslin or silk. This covering is kept wet by feeding water, by capillary attraction, from a vessel. The water is fed by using three or four threads—they may be ravelings from the cover—extending from the cover to the vessel. You can find the instrument in compact and convenient form at any place where thermometers and similar instruments are sold. 2. What is the best core-hardening mixture to be used in an open fire? *A.*—Prussiate of potash is as good as anything we know of. 3. What is the best compound for welding steel? *A.*—We know of nothing better than borax and finely-pulverized wrought iron.

(430) W. K. M. writes: I would like a simple rule for the solution of the enclosed problem. We have a given radius and perpendicular—want to find the angle of the hypothenuse. I have looked in vain for a rule given in a comprehensible form which can be used in every-day practice. I know it can be calculated by higher mathematics, but would like an easier way. I can readily get it by the use of the protractor and T square, but would like to know how to find it without resorting to them. *A.*—Divide the perpendicular by the hypothenuse; the quotient will be the sine of the angle. Look for this sine in a table of natural sines (a table of this kind can be found in any engineers' pocket book); opposite to this sine you will find the angle required. Thus, for instance: The hypothenuse is 6 inches, and the perpendicular is 2 inches; what will the angle formed between the hypothenuse and base of the triangle 2÷6 = 0.3333? In the table of natural sines the nearest sine to 0.3333 is 0.3332, and the angle opposite to this sine in the table is 19 deg. 28 min.

(431) J. E., Hantsford, Nova Scotia, asks for a rule for determining the probable horse-power of a compound engine. We do not know of any rule that will be satisfactory. If the capacity of the low-pressure cylinder is divided by the capacity of the high-pressure cylinder up to cut-off, the quotient will be the number of times the steam is expanded. Theoretically, if the steam was used in the low pressure cylinder under equal expansion, the power in the two cases would be the same. But practically the power developed by the single-cylinder engine would be the greatest. How great the difference will be can only be told by experiment, and will be modified by difference in construction. Builders find by practice about what the variation will be with the particular kind of engine they build, and so are able to estimate the power very correctly. In your case you can readily find what power, theoretically, the low-pressure cylinder alone would develop if the steam was admitted direct to it and cut-off, so as to work with the same expansion you get in the compound.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

J. Clayton, Air Compressors, Rock Drills, 43 Dey st, NY

Edw. Sears, Wood Engraver, 169 William st., N.Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., NY

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

20", 25," 28" B G. and S. F. upright drills for immediate delivery. Currier & Snyder, Worcester, Mass.

Ice and Refrigerating Machines. 120 built, and all successful, by David Boyle, 521 Monroe, Chicago, Ill.

Inventions, Models, Gear-cutting and light mechanical work. A. P. Brown, 108 Liberty st., N. Y.

Curtis Pressure Regulators, Curtis Return Trap. Curtis Damper Regulator. See Dec. 11, p. 12. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

Engine Lathes, Hand Lathes, and other fine tools, Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

Machinists' supplies, brass goods m'f'rs supplies, polishing materials, all kinds wire, metals, etc; in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co. 111 Liberty st., N. Y.

Handbook on the Care of Boilers. 50c. Descriptive Circular and Catalogue of Books for Mechanical Engineers free on application; special terms to Mechanics' Libraries. E. & F. N. Spon, Publishers, 35 Murray st., New York.

"Hints to Steam Users, Engineers and Firemen." A 100-page book on care of steam boilers; just issued; containing useful rules, tables, etc; a valuable book for engineers; sent on receipt of 25 cts. in stamps. J. N. Mills Pub. Co., 30 Vesey st., N. Y.

St. John Improved Self-adjusting Cylinder Packing, for marine and stationary engines and locomotives; applicable to water, air, oil and ammonia pumps. For durability and minimum of friction, it is unexcelled. Send for pamphlet. Address, Balance Valve and Piston Packing Co., room 58, 280 Broadway, New York.

Patent Binders for the AMERICAN MACHINIST, holding a complete volume (52 issues), simple, neat, durable. Price $1, prepaid, to any part of the United States by mail. To Canada or foreign countries the price will be 75c.; purchasers pay express charges and customs duties. AM. MACHINIST PUB'G CO., 96 Fulton st., N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2 post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

MANUFACTURES

Dent Terrell, Conyers, Ga., will erect a new plow factory.

Edward Speiman, of Pekin, Ill., will build a large distillery.

S. H. & D. Sayre, of Montrose, Pa., will build a new foundry.

Finch & Co., of Bayonne City, N. J., are building new stove works.

D. J. Bailie, 490 Cherry street, New York, will erect a $20,000 factory.

G. A. Schnibler, of Nazareth, Pa., contemplates erecting a new silk mill.

Doyle Bros., 125 East 109th street, New York, will erect a $9,000 workshop.

The Roanoke Machine Works, Roanoke, Va., are to be greatly enlarged.

Mr. Williams will erect a $17,000 factory at 234 Newberry street, Chicago.

Additions are being made to the Knoxville Woolen Mills, Knoxville, Tenn.

Pittsburgh expects soon to have the Studebaker wagon shops within her limits.

R. F. Divver, Anderson, S. C., will add an iron foundry to his machine shop.

H. D. Cooper and associates will erect a stove foundry at South Pittsburgh, Tenn.

Louis Duffy, Dallas, Texas, will rebuild the iron foundry of Duffy Bros., lately burned.

The Ohio River Railroad Company contemplates building shops at Jeffersonville, Ind.

The Boynton Company, of Jersey City, N. J., will erect a new foundry on Pacific avenue.

Rufus Crane, 421 Seventh street, Detroit, Mich., will erect a machine shop to cost $3,700.

Kent & Pyle, of West Grove, Pa., will establish a new knitting mill to employ 125 hands.

A. Kimble, of Rockford, Mich., will remove his foundry and machine shops to Mancelona.

Fred. Stroble, Marion, O., will establish a new factory for the manufacture of thrashers.

The New Jersey Wire Cloth Company, Trenton, N. J., is building a four-story brick factory.

The Knebel Engine Company, Birmingham, Ala., lately organized, will build a machine shop.

A new knife factory will be erected in Thomaston, Conn. George A. Stoughton is interested.

Davis & Davis, Lexington, N. C., will erect a foundry and machine shop at Salisbury, N. C.

The Dixie Foundry and Machine Company, Tyler, Texas, will rebuild their works, lately burned.

Samuel I. Dwight, Brooklyn, N. Y., will erect a $25,000 factory at Ninth street and Wythe avenue.

The Cortland Wagon Manufacturing Company, of Cortland, contemplate moving to Addison, N. Y.

The Pennsylvania Railway Company will build a large freight shed and round-house at Louisville, Ky.

The Hoppes Manufacturing Company, of Springfield, O., have increased their capital from $5,000 to $30,000.

George Heyman, 108 West Eighteenth street, New York, will erect a six-story brick factory to cost $18,000.

It is reported that a large stock company will be formed at Chattanooga, Tenn., to erect a large steam forge.

Charles H. Hooper, Marcellus, N. Y., will commence the erection of an extensive furniture factory at Fort Edward.

Magengast & Kemp, of Centreville, N. J., are building a new factory for the manufacture of improved coopers' tools.

The Studebacker Bros. Manufacturing Company, of South Bend, Ind., contemplates removing its wagon works to Oil City.

It is reported that the Pennsylvania Railroad Company will commence the erection of a large car manufactory at Sunbury.

The N. Y., N. H and H. Railroad will erect a small shop and round-house near the Grand Central Depot, New York city.

J. Forbing & Son, of Kenton, O., have bought three acres of ground at Lexington, Ky., and will build a large chair factory.

E. Gould & Eberhardt, Newark, N. J., have built a 75-foot addition to their machine tool works. Business is brisk with them.

E. C. Barth, of Atlanta, Ga., is building an extensive brick machine shop, which he will fit up with the latest improved machinery.

The Rumford Falls and Buckfield Railroad Company has commenced the erection of a large repair shop and car house at Buckfield, Me.

The Stevens Arms and Tool Company, Chicopee Falls, Mass., have recently added one story to their factory, and also built a new office.

The South Tredegar Iron Company, Chattanooga, Tenn., are changing the heating furnaces in their works so as to use coal gas in place of coal.

It is said that Fall River has been visited by representatives of the Singer Sewing Machine Company, with a view of locating the shops there.

The Keystone Watch Case Company, Nineteenth and Brown streets, Philadelphia, will erect a five-story factory, 34x81 feet, as an addition to their works.

The old Sharps rifle factory in Bridgeport, Conn., is being fitted up for use, and report has it that the New Howe sewing machine will be manufactured there.

The ladies who belong to the Knights of Labor in Indianapolis are soliciting stock for a co-operative factory for the manufacture of overalls, shirts and underwear.

R. D. Smith, Birmingham, Ala., has organized a company, with a large capital, to build two iron furnaces on the property of Smith & Eastman, near Birmingham.

The United States Agricultural Department of Washington, D. C., will erect $50,000 of sugar machinery in Louisiana to make sugar by the new diffusion process.

The Rumford Falls and Buckfield Railroad Company has commenced the erection of a large repair shop and car house at Buckfield, Me. Superintendent, L. I. Lincoln, Canton.

A movement is on foot to erect a 100-ton iron furnace in Montgomery, Ala. A subscription list is being circulated, and Moses Brothers head the list with $10,000.

Mrs. McFarland, one of a silk manufacturing firm at Yonkers, N. Y., has purchased a large lot in Phoenixville, Pa., upon which the firm will build at once a $20,000 factory.

It is reported that J. P. Witherow has contracted to erect at Sheffield, Ala., a coke blast furnace, 18 feet bosh and 75 feet high, for the Lady Ennesley Coal and Iron Company.

The Gulf, Colorado and Santa Fe Railroad Company (office, Galveston, Tex.,) have purchased a tract of land at Dallas, on which it is rumored machine shops are to be built.

The Trumbull Iron Company, Niles, O., will build an addition to their rolling mill. They propose putting in a 7-inch mill, two new heating furnaces and several new puddling furnaces.

The striking coopers of Milwaukee, being unable to come to an amicable settlement of their difficulties, have decided to start a co-operative cooper shop, and a company with a capital stock of $10,000 has been organized.

The Waugh Nail Mill, Belleville, Ill., is erecting an addition to cost $125,000. It will be completed some time in January or February, and give capacity to employ 100 more hands.

French officers have been inspecting the gun department of the E. Remington & Sons' works at Ilion, N. Y., with a view of purchasing the machinery for the manufacture of guns.

J. Y. Hamrick, Alexander Ferguson and Asbury Webb have leased the shops of the Cleveland Manufacturing Company, at Shelby, N. C., and will establish a new foundry and machine shop.

The town of Campton, N. H., has voted to exempt from taxation for five years any person or corporation that shall invest permanently the amount of $5,000 for manufacturing purposes in the town.

The Louisville and Nashville Railroad Company will build water works at Guthrie, Ky., at a cost of about $20,000. A woolen factory is reported to be erected as soon as the waterworks are completed.

The Jones & Lamson Machine Company, of Windsor, Vt., have nearly filled an order for machinery for the French Government, and will soon begin upon an order for the English Government.

The Norton Emery Wheel Company have just completed and occupied their new shops at Worcester, Mass. The building is 48x117 feet, three stories in height. They report business as being brisk.

Lodge, Barker & Co., Cincinnati, O., write us: "We are now moving our offices into our new buildings, devoting the space heretofore occupied by them to increasing our manufacturing facilities in our other plant."

Allentown, Pa., will have new manufactories completed by the first of the year that will give employment to 3,000 hands. They include two silk mills, a thread factory, furniture factories, and several iron works.

Wm. R. Clapp, of the Hampshire foundry at Northampton, Mass., is finishing a new brick building, 40x60, three stories high, adjoining the foundry. A portion of this will probably be let for manufacturing purposes.

Tyler Bros., Boston, are building a mill, 150x110 feet, for making lap-welded tubes and pipes. It will be fitted with the most improved appliances, and will be ready for occupancy about February 1st, 1887.—*Boston Commercial Bulletin.*

The Cripple Creek Iron Company—capital stock, $500,000—has been incorporated at Pulaski Station, Va., with A. J. Dull, of Harrisburg, Pa., as president, and Abram S. Patterson, of Philadelphia, secretary and treasurer.

The Tennessee Valley Iron and Railroad Company, recently organized at Memphis, will erect at once a 50-ton charcoal furnace and charcoal and chemical works half-way between Ætna, Hickman County, Tenn., and Sheffield, Ala.

John W. Robinson & Co. have sold their Foster Falls iron ore property (about 2,000 acres) in Pulaski County, Va., to William C. Bullitt and others, of Philadelphia, for $150,000. It is said that one or more furnaces will be erected by the purchasers.

Work was commenced on Monday on the new pipe mill of Spang, Chalfant & Co., Etna, Pa. The new building will be 78x100 feet, and be an addition to their lower pipe mill. A new furnace will be put in and about 150 men employed.—*American Manufacturer.*

The Kanawha and Ohio Railroad Company—Thomas R. Sharp, Charleston, W. Va., general manager—are preparing plans for machine shops to be erected in that city. It is stated that $30,000 of machinery will be purchased.—*Baltimore Manufacturers' Record.*

It is stated that W. H. Peacock, Wm. P. Armstrong and others, of Selma, Ark., propose to start a pipe factory, car works, car wheel works, tram wheel works, etc., at the new town of North Birmingham, near Birmingham, Ala.—*Baltimore Manufacturers' Record.*

A company to be known as the Pike Knitting Machine and Needle Co., J. W. Pike, 123 North Fourth street, Philadelphia, Pa., and Michael Reddy, Little Falls, N. Y., to manufacture the latch needle and knitting machinery. Business will be commenced January 1 with 50 hands.

The Sharon Wire Nail Company, of Sharon, Pa., builders of the Sharon wire nail machine, have completed arrangements for removing their works to Meadville. The Board of Industry of that place have, we understand, offered them flattering inducements.—*Industrial World.*

A. C. Conn is soon to have erected a mammoth barrel factory in Atlanta. Mr. Conn has been delayed in carrying out his purpose, but will begin at once the erection of his buildings. The machinery has already been purchased, and will be ready to place by the time the building is completed.

The Knowles Steam Pump Works, of Warren, Mass., have several water-works contracts on hand, which, with other work, have necessitated the building of the shop now in process of construction. This is a single-story shop, 220x50 feet, with a two-story head house for offices and drafting rooms.

A company has been formed in Philadelphia, with a capital of $150,000, for the purpose of manufacturing general machinery. A machine shop, 75x261 feet, will at once be erected at Fiftieth street and Marion avenue, and a foundry will also be built. W. L. Elkins, Jr., 47 North Second street, is president of the company.

Geo. S. Colton, manufacturer of elastic cords, braids, etc., at Norfolk, Conn., is about to remove his business to Easthampton, Mass. He is erecting there, near the line of the Connecticut River Railroad, a brick factory of three stories with basement. The building is to be 98x42 feet, with a boiler house 25x30 feet.

The Toledo Foundry and Machine Company, Toledo, O., builders of excavating machinery, are preparing to replace their wooden buildings with a three-story brick and iron machine shop, the main parts of which will be 50x100 feet and 62x65 feet respectively. They now employ 42 men, but expect to increase their force to 150 men.

The car shops at the Union Station, New Haven, Conn., are to be enlarged by the addition of a new brick building, 179x80 feet. Another structure, 80x?0 feet, is to be built, the lower floor of which will be used as a storeroom and shop, and the second floor by the superintendent of car shops, Denver, and his assistants.—*Manufacturers' Gazette.*

The car shops of the United States Rolling Stock Company at Hegewisch, Ill., are now in full running order, giving employment to nearly 700 men, who turn out on the average eighteen freight cars daily. Last week 111 cars and ten cabooses were completed. It is expected that the daily capacity will soon be increased to twenty-five cars.—*Railway Review.*

Ground has been staked out for the erection of a large foundry in Youngstown, O. The projector of the enterprise is Mr. John Miller, recently of the firm of Booth, Miller & Co., who has been engaged in the foundry and machine business there for the past twenty-five years. It is expected the plant will be completed and in operation within ninety days. The special product of the plant will be rolls.

The Fishkill Landing Machine Company, of Fishkill-on-the-Hudson, N. Y., have issued a very neatly-printed and well-illustrated pamphlet, descriptive of their Corliss engines. The engines are built both vertical and horizontal. They also build slide valve engines. A list of references to parties using their engines, as well as a lot of testimonials, are published in the pamphlet.

The Woonsocket and Millville (R. I.) shops of the Woonsocket Rubber Company, owing to an overproduction of rubber goods, have been obliged to temporarily suspend part of the help in both works, awaiting the enlivening in trade. Those who remain in the Millville shops will work seven hours per day, and those in the Woonsocket works will work eight hours.

Poole & Hunt, Baltimore, Md., have issued a finely-illustrated and neatly-bound catalogue of gearing, pulleys, sheaves, etc., manufactured by them. The lists are very complete, embracing all kinds of gearing and pulleys. The catalogue also contains several tables giving weight of rolled iron per foot, capacity of cisterns in gallons, rules for calculating the speed of gears and pulleys, and other valuable information.

The Bridgeport Boiler Works—Wm. Lowe, proprietor—Bridgeport, Conn., have been favored with an unusual and unexpected quantity and variety of orders, which will require all their facilities to get out in time, which extends into the new year. The orders are for the Lowe boilers, with the steam superheating drums and the improved front and furnace, from parties in three States—Connecticut, New Jersey and Illinois; the Lowe feed water heaters, for East, West and Southern States; horizontal tubular boilers and vertical tubular boilers, for power and steam heating, for house building, school and factory use; rubber vulcanizing heaters and pans for same; melting furnace chimneys up to 62" diameter, for malleable iron, steel and brass; smoke-stacks for boilers; tanks for factory, gas works, chemical works, and for rendering lard and for steamboat use, and several other varieties of work, which makes up a list seldom on orders at one time, and makes these works quite busy.

The Albany Steam Trap Company, Albany, N Y, write us as follows concerning a new filter they have just brought out: "We are at present engaged in the manufacture of a filter for manufacturing and domestic use. By its construction, in washing the filtering media, the unfiltered water is not used; the operation is to use one-half the filtering capacity of water to wash the other half, and *vice versa*. By this method it is impossible to get any water into the system of pipes for supplying the house that has not been filtered. And it also obviates the necessity of opening or closing several valves during the operation of washing, as it is done by the movement of one single lever; therefore, it becomes impossible for the operator to make any mistake in the way of opening and closing the valves. This filter is also provided with our sand valve, enabling us to use the finest sand and at the same time be positively sure that it cannot escape through the valve and get into the system of pipes, thereby destroying all the cocks and valves in the house system. We think it is safe to say that this is the only filter manufactured in the world having this positive assurance. We do not mean by this, filters that have the filtering media confined between perforated plates, but refer to filters that are arranged to wash the filtering media in a loose state, and used either under pressure or open to the atmospheric pressure."

James H. Lancaster, 187 Broadway, New York city, has just completed the erection, at Matthiessen & Wiecher's Sugar Refinery, Jersey City, N. J., of three patent fuel economizers of 768 pipes.

Machinists' Supplies and Iron.

NEW YORK, Dec. 1, 1886.

The condition of the pig iron market is without new features since the close of last week. The demand on the spot has continued moderate, and confined to the requirements of small consumers. No official announcement has yet been made respecting the basis for next year's contract, and none is expected until about the middle of December, but negotiations are in progress between the furnacemen and their regular consumers as to future requirements.

We quote: For American brands, No. 1 X Foundry, $19 to $19.50; inferior brands, $17.50 to $18; No. 2 Foundry, $17.50 to $18; Grey Forge, $16.25 to $16.75.

Scotch Pig—These brands are in moderate demand, with the tendency in buyers' favor. We quote Coltness, $21.50; Glengarnock, $19.50 to $20; Gartsherrie, $20.50 to $21; Eglinton, $19 to $19.25; Langloan, $21; Dalmellington, $19.50; Summerlee, $20.50 to $21.

Lead—The demand for spot deliveries was moderate; small lots have been sold at 4.40c. to 4.45c, but December deliveries have been obtainable at 4.35c., with very little disposition to buy.

Spelter—Ordinary brands sold at 4.35c. and 4.40c., and 4.70c. for choice.

Tin—The market ruled steady, but quiet. We quote for jobbing lots of Banca, 23c. to 23½c.; Straits and Malacca, 22.70c., cash, and 22.80c., 30 days.

Copper—There have been moderate sales of Lake ingot at 12c., and at this price the market has ruled quiet and steady.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Foreman with thorough knowledge of Corliss engines, competent and sober; state wages expected; references. Address M. J., AM. MACH.

Mech'l engineer—best of references, past experience railroad and marine engine work—wants situation as master mechanic. Address E. B., AM. MACHINIST.

Position as superintendent or draftsman in shops doing engine and machinery building: West preferred. A. S. M. E., care Am. MACHINIST.

Wanted—Situation as foreman patternmaker; 20 years' experience; also a draftsman; good references. Address K. K., AM. MACHINIST.

Machinist foreman wanted, who can handle fifty men to advantage, and increase their production by latest improved ways of doing work. Address P., care Wilkinson & Co., 352 Atlantic av., Boston, Mass.

A brass manufacturing company, with an established trade in steam appliances, on which they control letters patent, desire to secure the services of an energetic man to superintend the manufacture of above and other specialties in brass. State qualifications, habits, etc., and, if found satisfactory, said party can secure an interest should he so desire. Address N. L. Hayden, Quincy, Ill.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 25 cents per line, each insertion.

Crescent Boiler Tube Expander; second to none, price in reach of all. Crescent Mfg. Co., Cleveland, O.

The Crescent Link Belt Coupling; something new; sample free. Crescent Mfg. Co., Cleveland, O.

Light mach'y of all kinds built at short notice Edmund Mills, 8 Dey st., Jersey City Heights, N. J.

John Lamberty, mfr. telegraph and electrical instruments, experimental machs, models; fine gear cutting a specialty. 35 S. 5th st., Br'kl'n, E.D., N.Y.

Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. Weston & Smith, Syracuse, N. Y.

Experimental and new machinery for special purposes built by contract from specifications and inventors' designs; ample facilities. Cohoes Iron Foundry and Machine Co., Cohoes, N. Y.

For Sale—One complete set of Pulley Patterns also Patterns for Slide Valve Engines, with adjustable cut-off and without cut-off, for sale cheap Address North Star Iron Works Co., Minneapolis, Minn.

For Sale—The machinery, tools, plating apparatus and raw material of manufacturing establishment; now working on orders in brass and other metals; very low rent, including steam power. Address Manfr., P.O. Box, 285, New Brunswick, N.J.

For Sale—A first-class foundry and machine shop; large connection in saw-mill county in the South, including buildings, lots, machinery, and mills' supply stock on hand; business will be carried on until sold; reason for selling, retiring from business; apply at or address Southern Foundry, AM. MACHINIST.

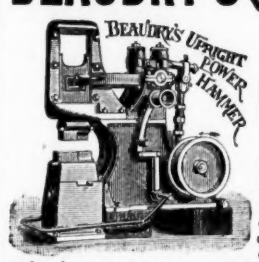
BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Established 1832.

Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other Hammer in the World.

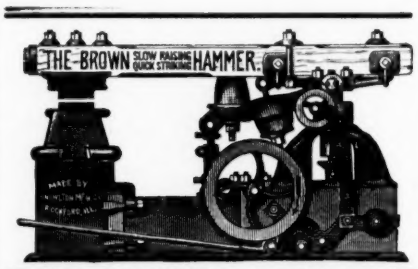
BRADLEY & CO. Syracuse, N.Y.

BEAUDRY'S UPRIGHT CUSHIONED POWER HAMMER



The success of our machine is the best proof of its value. Is more like a steam-hammer than any other, yet has all the economic advantages of a power hammer, and is far superior to any. Will work a larger bar of steel or iron and turn out more difficult forgings than any other hammer made. Guaranteed as represented, or no sale.

BEAUDRY & CUNNINGHAM, Boston, Mass.



THE BROWN HAMMER STRIKES A BLOW WITH Double the Velocity That It Raises the Hammer. A NEW MOVEMENT! SEND FOR DESCRIPTION. Knowlton Mfg. Co., King St., Rockford, Ill.

STEPHENS' PATENT VISES.

50 PER CENT. OF time and labor saved by using this solid, strong, durable, quick-working Vise. Has the Improved Taper, Pipe and other attachments. Sold by the trade. Send for circular

MELVIN STEPHENS, Prop'r. Office, 41 Dey Street, New York

H.W. JOHNS' ASBESTOS ROOFING

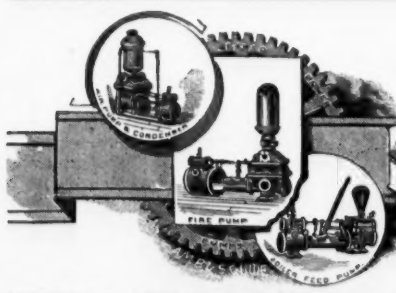
FIRE AND WATER-PROOF BUILDING FELT, FIRE-PROOF PAINTS, STEAM PACKINGS, BOILER COVERINGS, ETC.

Samples and descriptive Price List free by mail.

H. W. JOHNS MFG. CO., 87 MAIDEN LANE, N. Y.

CHICAGO, PHILADELPHIA, LONDON.

KNOWLES Steam Pump Works.

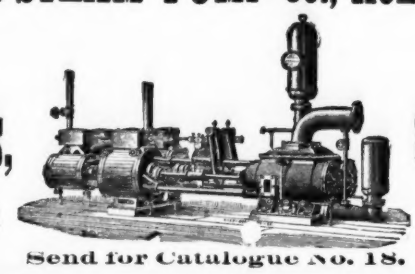


93 Liberty St. NEW YORK. | 44 Washington St. BOSTON.

IMPROVED PUMPING MACHINERY For Every Class of Work SEND FOR NEW ILLUSTRATED CATALOGUE.

THE DEANE STEAM PUMP CO., HOLYOKE, MASS.

BUILD WATER WORKS, ENGINES AND STEAM PUMPING MACHINERY.



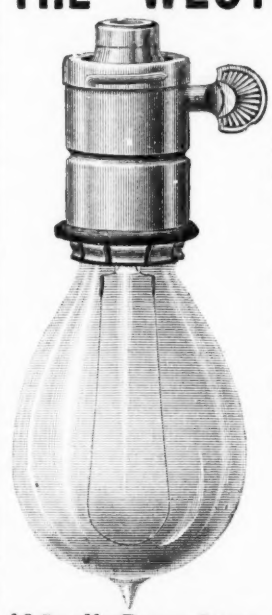
Send for Catalogue No. 18.

THE HENDEY MACHINE COMPANY, TORRINGTON, CONN.

SHAPERS, PLANERS, LATHES, DRILLS, and SPECIAL MACHINERY,

SEND FOR CATALOGUE.

THE WESTINGHOUSE ELECTRIC CO. OF PITTSBURGH,



16 Candle-Power Lamp. (Half Size.)

Manufacturers of Isolated Incandescent Plants, and Contractors for Central Stations.

It is believed that the advantages of our system place us beyond competition.

Capital investing for dividends will do well to close no contracts until our proposals are considered.

Address

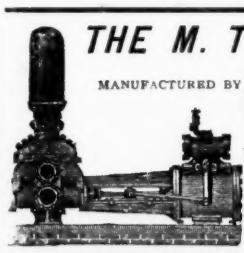
THE WESTINGHOUSE ELECTRIC CO. Pittsburgh, Pa.

or

WESTINGHOUSE, CHURCH, KERR & CO. 17 Cortlandt St., New York.

THE M. T. DAVIDSON IMPROVED STEAM PUMP,

MANUFACTURED BY DAVIDSON STEAM PUMP COMPANY.



WARRANTED THE BEST PUMP MADE FOR ALL SITUATIONS.

PRINCIPAL OFFICE, No. 77 LIBERTY STREET, N. Y.

NEW ENGLAND OFFICE, 51 OLIVER STREET, BOSTON, MASS.

Established in 1874.

CLEVELAND TWIST DRILL CO.

24 and 26 West Street, Cleveland, O
101 Chambers Street, New York.
85 Queen Victoria St., London, Eng.

GUILD & GARRISON, BROOKLYN, N. Y.

STEAM PUMPS, VACUUM PUMPS, AIR COMPRESSORS.

SEND FOR CATALOGUE.

SPECIAL SALE.

1 18 in. x 6 ft. Engine Lathe.
1 16 in. x 6 ft. Speed Lathe.
1 16 in. x 6 ft. Speed Lathe, with milling attachment.

Small Speed and Engine Lathes, Shapers and Drills.

1 Iron Frame Saw Table.
1 6 in. One-side Moulder.
1 30 in. Grist Mill.

Anvils and Vises.

A SPECIAL IMPORTATION.

COOKE & COMPANY, 22 Cortlandt St., New York.

Agents for Wiley & Russell's Screw Plates, Bolt cutters, Etc.

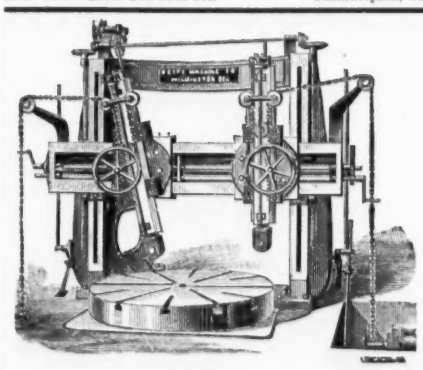
IN WRITING MENTION THIS PAPER.

JUST ISSUED. NEW EDITION.

ROPER'S Hand-book of Land and Marine Engines.

Containing a description and illustrations of every description of land and marine engines. $3.50 post paid. Roper's Practical Hand Books for Engineers and Firemen. Catalogues free.

EDWARD MEEKS, Publisher, S. E. Cor. Walnut and 10th Sts. - - Philadelphia, Pa.



Boring and Turning Mills

MADE BY

BETTS MACHINE CO.

WILMINGTON, DEL.

NOTE THE FOLLOWING ADVANTAGES.

Positive feeds, no friction.
Spindles entirely independent, can be moved simultaneously in opposite directions with different grades of feed.
Spindles not round, but of such shape as will allow ready adjustment for wear.
Great range of feed and abundance of power

NICHOLSON FILE COMPANY, *Sole Mfrs. of*

FILES and RASPS Having the Increment Cut. also, FILERS' TOOLS and SPECIALTIES.

The above illustration represents a device in which files may be held for service in surface filing, and while in this condition READILY SPRUNG, in order to give at the will of the operator, more or less convexity to the working face of the file. It does away with unusual care to obtain a true convexity or "belly" to file sides, and in fact renders great service by enabling the operator to utilize the file to its full capacity.

SURFACE FILE HOLDER No. 4, Adapted to Hold Files 12, 13 14 in. Long.
" " " " 5, " " " 14, 15, 16 "

MANUFACTORY AND OFFICE - - PROVIDENCE, R. I., U. S. A.

REDUCED PRICES OF LeCOUNT'S STRAIGHT TAIL DOG.

To be driven from a Stud in the Face Plate.

No.	INCH.	PRICE.	No.	INCH.	PRICE
1	¾	$0.60	10	2¼	$1.35
2	⅞	.70	11	2½	1.45
3	1	.70	12	3	1.60
4	1⅛	.80	13	3½	1.80
5	1¼	.80	14	4	2.10
6	1⅜	.95	15	4½	2.75
7	1½	.95	16	5	3.25
8	1¾	1.10	17	5½	4.00
9	2	1.20	18	6	5.00
1 Set to 2 in.		7.80	Full Set		31.10

C. W. LeCOUNT, South Norwalk, Conn.

THE HANCOCK INSPIRATOR.

THE STANDARD

BOILER FEEDER FOR ALL CLASSES OF BOILERS.

OVER 85,000 IN USE.

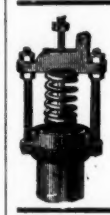
Send for Circulars and Price Lists.

THE HANCOCK INSPIRATOR CO.

OFFICE, 33 INDIA WHARF, BOSTON, MASS.

WALKER'S TOOL HOLDER

For holding drills and reamers for lathe work. Prevents breaking or slipping. Can also be used for drilling and reaming holes by hand, and for reaming holes under drill presses, etc. Made with double handle, when required. WALKER MFG. CO, Cleveland, Ohio.



Lynde's Pat.

Pop Safety Valves,

Adapted to all Boilers.

J. E. Lonergan & Co.,

Sole Owners and Manuf'rs

PHILA., PA.

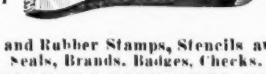
CUPOLA *Polishing Frame.*

ON WHICH TO RUN WOODEN POLISHING WHEELS.

Emery Wheels, Grinding Machinery and Tools, and Polishing and Plating Goods of all kinds.

UNION STONE COMPANY,

38 and 40 Hawley St., BOSTON, MASS.

Steel  Stamps

Ribbon and Rubber Stamps, Stencils and Supplies, Seals, Brands, Badges, Checks, etc.

The HOGGSON & PETTIS MFG. CO. New Haven, Ct

Established 1846. Send for 72 page catalogue.

THE NEW "GRESHAM" PATENT AUTOMATIC RE-STARTING INJECTOR

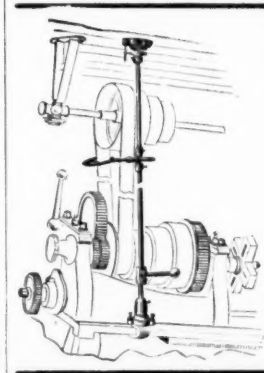
"Invaluable for use in Traction, Farm, Portable Marine and Stationary Boilers of all kinds. No handles required. Water supply very difficult to break. Capability of restarting automatically, immediately after interruption to feed from any cause."

SEND FOR CATALOGUE. RELIABLE AND CHEAP.

Sole Manufacturers in the United States & Canada,

NATHAN MANUFACTURING Co.

92 & 94 LIBERTY ST., NEW YORK.



CONE PULLEY BELT SHIFTER.

With this device, Belts on Cone Pulleys can be shifted as easily as from tight to loose pulleys. Saves time, annoyance and wear on belts. Dispenses with Belt "Stick."

SENT ON THIRTY DAYS' TRIAL.

Satisfaction guaranteed. Send for Circulars and prices to the manufacturers or their agents.

MANUFACTURED BY

POST & COMPANY, CINCINNATI, O.

DEALERS IN

MACHINERY AND RAILWAY SUPPLIES.

AGENTS:—Geo Place Mach'y Co., New York. Palmer, Cunningham & Co. (Limited), Philadelphia. U. Baird Machinery Company. Pittsburgh. C. H Besly & Co., Chicago.

P.H. & F.M. ROOTS,

Connersville, Indiana,

MANUFACTURERS OF

PORTABLE FORGES, TUYERE IRONS, ETC.

ROOTS' NEW ACME HAND-BLOWERS.

Slow-speeded, Force-blast. Durable, Compact and Cheap.

Roots' Foundry Blowers, Gas Exhausters, etc.

S. S. TOWNSEND, Gen. Agt. } 22 CORTLANDT ST.,
COOKE & CO., Selling Agts, } NEW YORK.

In Writing, Please Mention This Paper.

AMERICAN EXHIBITION, LONDON, 1887

A LONDON FIRM, *owning prominent space, will represent and exhibit AMERICAN MANUFACTURES and INVENTIONS. Inclusive charges, $50 upward, and Commission on results. Full particulars furnished by*

JAMES H. LANCASTER,

Consulting Engineer, 187 BROADWAY, NEW YORK.

FOR SALE. SECOND-HAND MACHINERY.

1 No. 5 Diamond Emery Grinder.
1 20 in. Prentice Drill Press.
1 20 in. Bickford Drill Press.
1 15 in. x 6 ft. bed Engine Lathe.
1 15 in. x 8 ft. bed Engine Lathe.
1 13 in. x 5 ft. bed Engine Lathe.

ALL THE ABOVE ARE IN GOOD ORDER AND ARE BARGAINS.

Also New 8, 12 and 14 in. Swing Foot or Power Lathes, our own make.

Send for our New Catalogue.

SEBASTIAN, MAY & CO.

No. 167 West 2nd Street, Cincinnati, Ohio.

HILL, CLARKE & CO., STEEL, IRON AND BRASS WORKING MACHINERY.

Screw Cutting Engine Lathes, Pulley Machinery, Pipe Threading Machines, Screw Machines, Chucking and Boring Machines, Bolt Threading Machines, Planers and Shapers, Milling Machines, Upright Drilling Machines, Boring Mills, Steam and Belt Hammers, Etc., Etc.

42 OLIVER ST., BOSTON, MASS.

P. BLAISDELL & CO.

Manufacturers of

Machinists' Tools.

WORCESTER. MASS.

Lubricate Your Engine Cylinders

perfectly, gain power and save oil by using our Patent Automatic Sight Feed Lubricators, showing oil as it enters, drop by drop.

The Seibert Cylinder Oil Cup Co.

H. A. ROGERS, Agent for New York.

19 John Street, New York.

STEAM ENGINE, ETC.

DUBOIS' Weisbach's Steam Engine, 8vo cloth,	$5 00
DUBOIS' Rontgen's Hot Air Gas and Steam Engines, 8vo cloth	5 00
CLERK'S Gas Engine, 12mo. cloth	2 50
GRIMSHAW'S Steam Engine Catechism, 18mo, cloth	1 00
MAW'S Chief Types Modern Marine Engines, folio, one half morocco	18 00
SINCLAIR'S Locomotive Engine, 12mo, cloth,	2 00
THURSTON'S Stationary Engines for Electricity, 8vo, cloth	2 00
TROWBRIDGE'S Stationary Steam Engines, 4to, cloth	2 50

VENTILATION.

BALDWIN'S Steam Heating for Ventilating, etc. 12mo, cloth	2 50
LEED'S Treatise on Ventilation, 8vo. cloth	1 50
MOTT'S Air We Breathe and Ventilation, 16mo, cloth	1 25
REID'S Ventilation in American Dwellings, 8vo, cloth	1 50
WILSON'S Practical Mine Ventilation, 16mo, cloth	1 25

Published and for sale by

John Wiley & Sons, 15 Astor Place, New York.

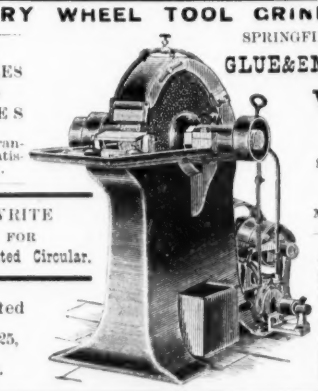
—Catalogues and Circulars Gratis.—

PATENT UNIVERSAL SCREW-CUTTING, CENTER, DEPTH, ANGLE AND TWIST DRILL GAUGE.

J. WYKE & CO. Fine Machinists' Tools. E. BOSTON. MASS. Send for Circular.

EMERY WHEEL TOOL GRINDER.

55 STYLES AND SIZES — Guaranteed Satisfactory.



SPRINGFIELD GLUE & EMERY Wheel Co. Springfield, MASS.

WRITE FOR Illustrated Circular.

Patented Sept. 25, 1883.

Water Prevents HEATING THE WORK

BEMENT, MILES & CO.

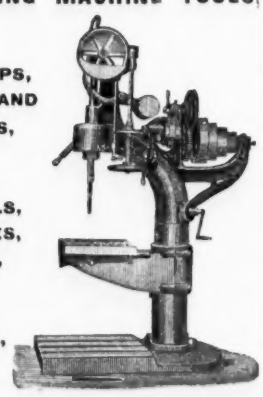
PHILADELPHIA, PA.

BUILDERS OF

METAL-WORKING MACHINE TOOLS,

FOR

RAILROAD SHOPS, LOCOMOTIVE AND CAR BUILDERS, MACHINE SHOPS, ROLLING MILLS, STEAM FORGES, SHIP YARDS, BOILER SHOPS, BRIDGE WORKS, ETC.



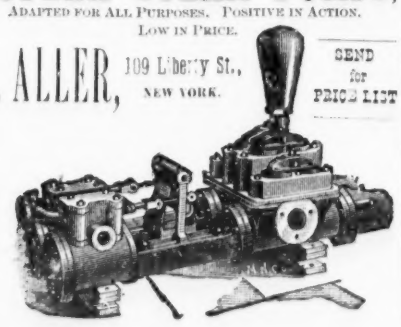
—IMPROVED—

DUPLEX STEAM PUMPS,

ADAPTED FOR ALL PURPOSES. POSITIVE IN ACTION. LOW IN PRICE.

A. ALLER, 109 Liberty St., NEW YORK.

SEND for PRICE LIST



FOR SALE AT A BARGAIN.

Fine Water Power on Raquette River. Small Foundry and Machine Shop, with flasks and patterns. Agricultural Region. Saw Mills and Tanneries within easy reach. Shop has made a specialty of water wheels, horse powers, farm machinery and mill repairs. Excellent railroad facilities. Good dwelling and 3 acres of land included. Will be sold at half its value to close an estate. Full particulars on application. Mead & Paddock, Attys., Malone, N. Y.

S. Ashton Hand Mfg. Co., Toughkenamon, Pa.

Hand's Twist Drill Grinding Attachment.

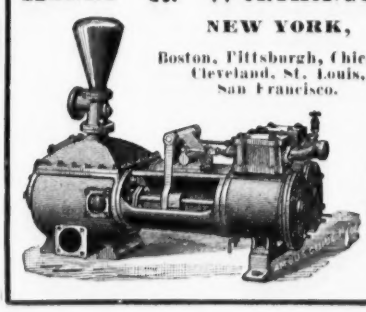
Readily attached to any grindstone, emery or cutter-grinder. Grinds right and left hand drills from 3/8" diam. down to smallest sizes made. PRICE, $20.

WORTHINGTON PUMPING MACHINERY

HENRY R. WORTHINGTON,

NEW YORK,

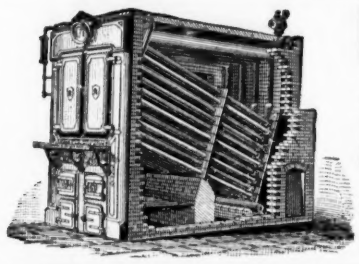
Boston, Pittsburgh, Chicago, Cleveland, St. Louis, San Francisco.



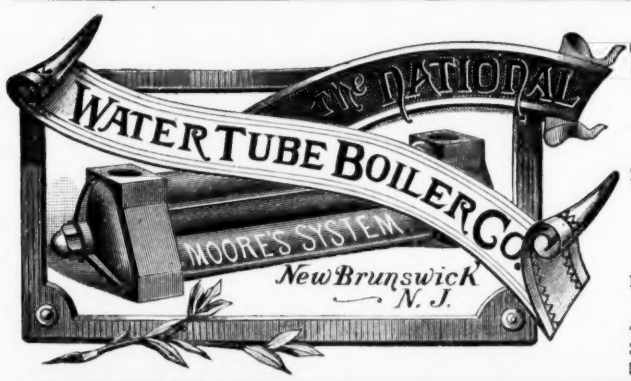
Illustrated Catalogue SENT ON

SAFE ECONOMICAL DURABLE BOILERS
HARRISON SAFETY BOILER WORKS. PHILADELPHIA, PA.
MERITS PROVEN 20 YEARS RECORD

"STEAM" A VALUABLE BOOK for EVERY STEAM USER AND ENGINEER
PUBLISHED FOR FREE DISTRIBUTION, BY
THE BABCOCK & WILCOX CO.
Manufacturers of
WATER-TUBE BOILERS,
107 Hope St., GLASGOW. *30 Cortlandt St., NEW YORK.*

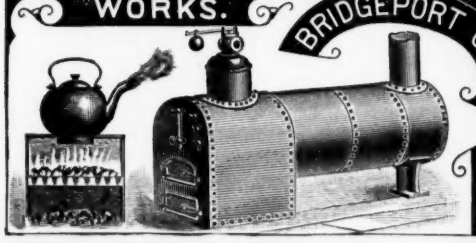


ROOT'S NEW WATER-TUBE STEAM BOILER
SAFE! ECONOMICAL! DURABLE!
FOR ILLUSTRATED CATALOGUE OF NEW BOILER, ADDRESS
ABENDROTH & ROOT MANUFG. CO.
—*28 CLIFF STREET, NEW YORK.*—
SELLING AGENTS,
A. B. ENSIGN, Rochester, New York.
A. S. FISKE, 41 Johnston Building, Cincinnati, Ohio.
WILLIAM H. SMITH, 115 Dearborn Street, Chicago, Ills.
DANIEL KELLY, 51 N. 7th Street, Philadelphia, Pa.
R. L. WEEKS, 151 Griswold Street, Detroit, Mich.
CHARLES E. ASHCROFT, 49 Mason Building, Boston, Mass.



—OUR—
WATER-TUBE BOILERS
ARE
UNSURPASSED
FOR
SAFETY, ECONOMY AND DURABILITY.
MAIN OFFICE,
New Brunswick, N. J.
BRANCHES:
49 NORTH 7th St., Philadelphia.
36 CORTLANDT ST., New York.
50 OLIVER ST., - Boston.

BRIDGEPORT BOILER WORKS.
BRIDGEPORT CONN.



SEE THE IMPROVEMENTS IN STEAM BOILERS, BOILER FRONTS, BOILER FURNACES, AND FEED WATER HEATERS MADE AT THESE WORKS BEFORE BUYING STEAM PLANT. SEND FOR HISTORIES OF STEAM BOILERS AND FFED WATER HEATERS (FREE) ON MENTIONING THIS PAPER. WM. LOWE.

ECONOMICAL STEAM BOILERS
A SPECIALTY.
SEND FOR PRICES. Pond Engineering Co. ST. LOUIS, MO.

I.W.COLBURN & Co.
FITCHBURG, MASS.
109 MAIN ST.
LOWEST LIVING PRICES ARC AND INCANDESCENT LIGHTING AND PLATING MACHINES.

SHAPING MACHINES
For Hand and Power, 6", 8" and 10" Stroke.
Adapted to all Classes of Work to their capacity.
CIRCULARS FURNISHED.
BOYNTON & PLUMMER,
Worcester, Mass.

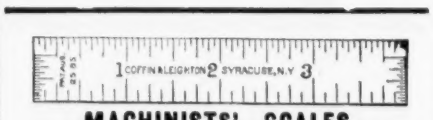
WHY THIS IS PUT HERE!
For the reason that if you are interested in raising water or other liquids by steam power, we wish to call your attention to the
NEW PULSOMETER,
THE CHEAPEST AND BEST STEAM PUMP IN THE MARKET. PRICES LOWER THAN ANY OTHER
More Efficient, Simple, Durable, and more Economical, both as to running expenses and repairs, than any other Steam Pump.
Call or write for our new 96 page Illustrated Descriptive Book containing Full Particulars, Reduced Net Prices, and hundreds of A-1 Testimonials. Mailed Free.
PULSOMETER STEAM PUMP CO., 83 JOHN STREET, N. Y.

SEBASTIAN, MAY & COMPANY'S
Improved Screw Cutting
Foot or Power Lathes

Catalogue of Lathes, Drill Presses and Machinists' Tools and Supplies mailed on application. Lathes on Trial.
167 W. Second St., Cincinnati, O.

THOS. H. DALLETT & CO.
13th & Buttonwood Sts., PHILA. PA
Manufacturers of
PATENT
Portable Drilling Machines,
VERTICAL DRILLS,
Radial Drills, Multiple Drills,
HAND DRILLS.
SEND for ILLUSTRATED CATALOGUE.

FORBES & CURTIS,
BRIDGEPORT, CONN.
Manufacturers of
The Forbes Pat. Die Stocks,
Power Pipe Cutting and Threading Machines, Cutting-off Machines, Ratchet Drills, Special Machinery, etc., etc.
WRITE FOR CATALOGUE
Mention Paper.



MACHINISTS' SCALES,
Patent End Graduation.
We invite comparison for accuracy with all others.
Every Scale Guaranteed. Send for List.
COFFIN & LEIGHTON, SYRACUSE, N. Y.

A FAIR OFFER.
If you will put a JENKINS BROS. VALVE, on the worst place you can find, where you cannot keep other valves tight, and if it is not perfectly tight or does not hold Steam, Oils, Acids, or other fluids longer than any other Valve, you may return it, and your money will be refunded.
IF YOU WANT THE BEST, CALL FOR "JENKINS BROS." VALVES.
JENKINS BROS.,
71 John St., New York. 13 So. Fourth St., Phila. 79 Kilby St., Boston.

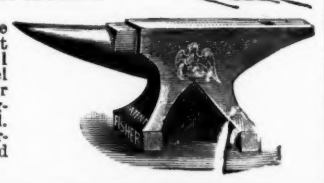
Oneida Steam Engine & Foundry Co., Oneida, N. Y.
Manufacturers of all kinds of LATHE —AND— DRILL CHUCKS
Under Westcott's Patent.
SEND FOR CATALOGUE.

Capacity Little Giant Improved.		
No. 00.	holds 0 to	1/4 inch.
" 0	" 0 to	3/8 "
" 1	" 0 to	5/8 "
" 2	" 0 to 1	"
" 2½	" 0 to 1	"

The United States Mitis Company,
26 BROADWAY, NEW YORK.
is prepared to issue licenses for the use of patents covering processes for the production of "Mitis Castings" in wrought iron and steel, and furnaces for melting and heating.
"Mitis" Castings retain in every respect all the valuable qualities of the wrought iron and steel (scrap) from which they are made. Do not require annealing. Can be welded and worked under the hammer as well as the raw material.
W. F. DURFEE, General Manager.

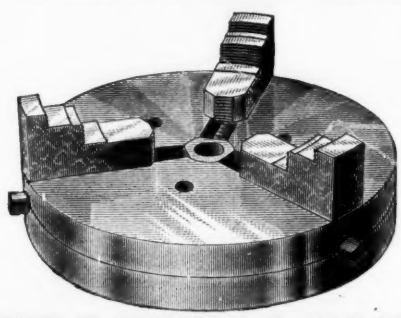
EAGLE ANVIL WORKS,
Trenton, N. J.

The Fisher Double Screw Leg Vise.—Warranted stronger grip than any other Vise. Always parallel and cannot be broken.
Send for Circulars.

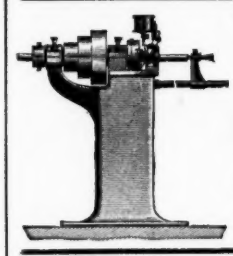


The Eagle Anvil.—Best Cast Steel Face & Steel Horn. Better than any English anvil. Fully warranted and lower price.

ESTABLISHED 1851.
THE HORTON LATHE CHUCK.



THE E. HORTON & SON CO.
Canal St., Windsor Locks, Conn., U. S. A.



William Barker & Co.
Manufacturers of
IRON AND BRASS
—WORKING—
MACHINERY
140 & 142 E. Sixth Street,
N'r Culvert, Cincinnati, O.
Send for circulars and prices.

MARCUS RUTHENBURG.
STEAM GENERATION.
MOTIVE POWER. STEAM HEATING.
64 W. 3RD ST.
CINCINNATI, OHIO.

WELDLESS STEEL TUBES
COLD DRAWN
QUICK OPENING GATE VALVE
SMOOTH INSIDE & OUT.
JOHN S. LENG
4 Fletcher St N.Y.

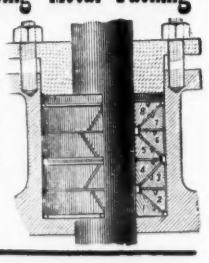
E. P. B. SOUTHWORTH,
94 Exchange street, Rochester, New York.
Indicating Engineer and Mechanical Draftsman.
Correspondence solicited.

THE ELLIOTT DRILL PRESS (Which always was good) Has Recently Been Much Improved.
Send for Particulars.
STERLING ELLIOTT, NEWTON, MASS.

NEW ENGINEERS' WRENCH.

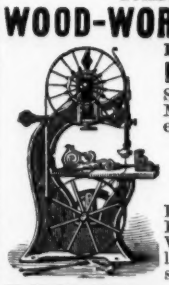
Bolster prevents screw from springing, or becoming loose. Ferrule is long, solid and strongly riveted, nut is deeply corrugated, making screw turn easily.
S. T. MOORE, 112 Chambers Street, New York.

Katzenstein's Self-Acting Metal Packing



For Piston Rods, Valve Stems, etc., of Steam Engines, Pumps, etc., adopted and in use by leading engine builders, mills, iron works and steamship companies all over the world. Also flexible tubular metal packing for slip joints on steam pipes, and for hydraulic pressure.
L. Katzenstein & Co.,
357 WEST STREET, N. Y.

J. A. FAY & CO. CINCINNATI, OHIO, U.S.A.
BUILDERS OF IMPROVED
WOOD-WORKING MACHINERY



Embraces nearly 400 Machines for
PLANING & MATCHING
Surfacing, Moulding, Tenoning, Mortising, Boring, and Shaping, etc.
Variety and Universal
WOOD WORKERS.
Band, Scroll and Circular Saws, Resawing Machines, Spoke and Wheel Machinery, Shafting, Pulleys, etc. All of the highest standard of excellence.
W. H. DOANE, Pres't. D. L. LYON, Sec'y.

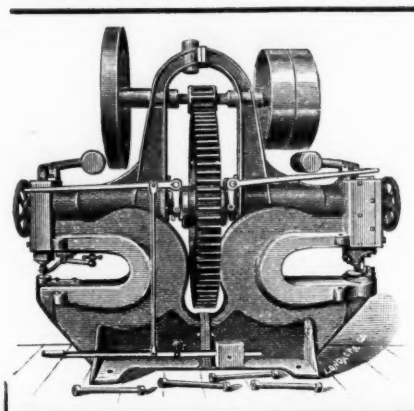
Barnes' Pat. Upright Drills
20-inch Swing, with both Worm and Lever Feed.

Barnes' Pat Engine Lathe
15-inch swing, 6-foot or 8-foot Bed.
These machines are made a specialty in our factory, they have advantages not found in other machines in this line. It will pay parties desiring to purchase, or know more about this class of machines, to send for full description and prices.
W. F. & JOHN BARNES CO.
1995 Main St., Rockford, Ill.

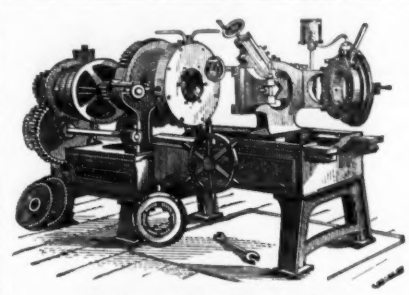
MACHINERY, TOOLS and SUPPLIES.
Complete Outfits for
MACHINISTS, BLACKSMITHS, MODEL MAKERS, JEWELERS, ETC.
Lathes, Planers, Shapers, Drill Presses, Emery Grinders, Milling Machines, Bolts, Screws, Washers, Belting, Packing, Waste, Twist Drills, Taps, Reamers, Cold Rolled Shafting, Hangers, Files.
SEND FOR ILLUSTRATED PRICE LIST OF METAL-WORKERS' TOOLS, ALSO WOOD-WORKERS'.
TALLMAN & McFADDEN, 1025 MARKET STREET, PHILADELPHIA.

Morse Twist Drill and Machine Company, New Bedford, Mass.
Manufacturers of Morse Patent Straight-Lip Increase Twist Drills.

SOLID AND SHELL REAMERS, BEACH'S PATENT SELF-CENTERING CHUCK, BIT STOCK DRILLS.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.

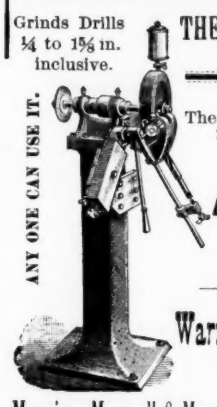


HILLES & JONES,
WILMINGTON, DEL.
PUNCHES & SHEARS
Improved
A FULL LINE OF Horizontal Punches.
BOILER-SHOP TOOLS.



SEND FOR CIRCULAR.

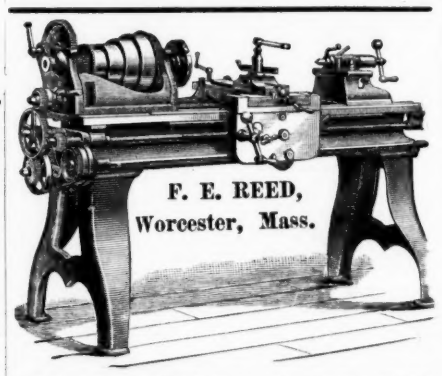
D. SAUNDERS' SONS,
Manufacturers of
Pipe Cutting & Threading Machines
For Pipe, Mill and Steam Fitters' Use.
TAPPING MACHINES,
For Steam Fitting, also
Steam and Gas Fitters' Hand Tools.
YONKERS, N. Y.



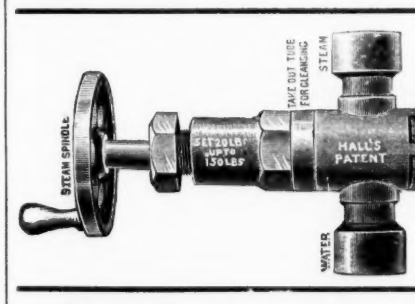
Grinds Drills ¼ to 1⅝ in. inclusive.
ANY ONE CAN USE IT.
THE HOUGH TWIST DRILL GRINDER
The SPECIAL CLAIMS made for this Tool are its
Simplicity, Ease of Operation, Low Price.
—MANUFACTURED BY—
Warner & Hough Machine Co.
ST. PAUL, MINN.
Manning, Maxwell & Moore, 111 Liberty St., New York. | Tallman & McFadden, 1025 Market St., Phila.

DROP FORGINGS OF IRON OR STEEL
BEECHER & PECK, NEW HAVEN CONN.
PECK'S PAT. DROP PRESS.
BEECHER & PECK, NEW HAVEN CONN.

MACHINERY For Reducing and Pointing Wire.
Especially adapted to pointing wire rods and wire for drawing.
For Machines or information, address the manufacturer.
S. W. GOODYEAR, Waterbury, Ct.

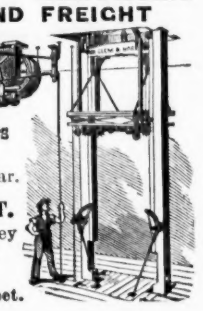


F. E. REED, Worcester, Mass.
ENGINE Lathes, Hand Lathes, Foot Lathes, Upright Drills and Milling Machines. Agents, Manning, Maxwell & Moore, 111 Liberty Street, New York.



American Twist Drill Company's
PATENT CHUCK JAWS.
Three sizes. Price per set of 4 Jaws, $40, $48, $56. Bolted to lathe face plates, they make best and cheapest chuck in the world. Address orders,
HILL, CLARKE & CO., Boston and St. Louis,
MANNING, MAXWELL & MOORE, N. Y. City,
TALLMAN & McFADDEN, Philadelphia, Pa.,
or WM. BINGHAM & CO., Cleveland, Ohio.

MORSE ELEVATOR WORKS
MORSE, WILLIAMS & CO.,
Successors to CLEM & MORSE, Builders of all Kinds of
PASSENGER AND FREIGHT
Elevators,

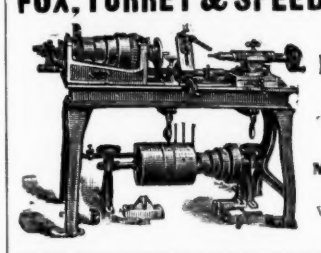


Automatic Hatch Doors
A SPECIALTY.
Send for Illustrated Circular.
Office, 411 CHERRY ST.
Works, Frankford Av., Wildey and Shackamaxon Sts.,
PHILADELPHIA.
N.Y. Office, 108 Liberty Street.

L. W. Pond Machine Co.
Manufacturers of and Dealers in
IRON WORKING MACHINERY.
Iron Planers A Specialty.
140 Union St. Worcester, MASS.

VOLNEY W. MASON & CO.,
Friction Pulleys, Clutches and Elevators,
PROVIDENCE, R. I.

FOX, TURRET & SPEED LATHES

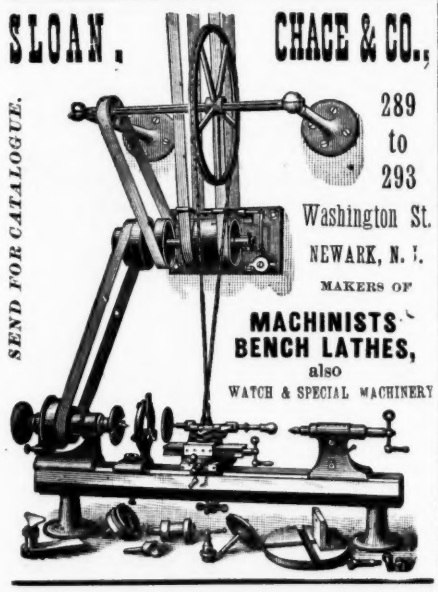


AND BRASS FINISHERS' TOOLS,
CAGE MACHINE WORKS,
WATERFORD, N. Y.

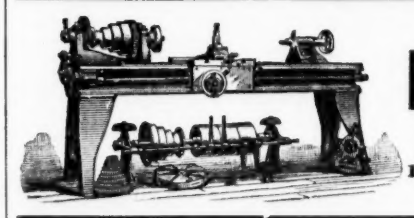
THE SANITARY ENGINEER and CONSTRUCTION RECORD,
AN ILLUSTRATED WEEKLY DEVOTED TO ENGINEERING, ARCHITECTURE, CONSTRUCTION, and SANITATION, of special interest to Civil Engineers, Architects, Builders, Contractors, Water and Gas Companies, Plumbers, Steam and Hot-Water Fitters, Managers of Public Institutions, Municipal Officers, and all persons building or interested in public improvements.
Published Saturdays at 140 William Street, New York.
$4.00 per year. 10 cents a copy of newsdealers.
Trial Subscription, *three months*, *One Dollar.*

HALL'S
Patent Automatic
INJECTORS.
SIMPLE and RELIABLE.
2 Lbs. to 150 Lbs. Steam.
20,000 NOW WORKING.
Hall's Engineering Co
112 John St., . . New York

SLOAN, CHACE & CO.,

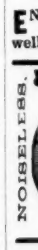


SEND FOR CATALOGUE.
289 to 293 Washington St.
NEWARK, N. J.
MAKERS OF
MACHINISTS' BENCH LATHES,
also
WATCH & SPECIAL MACHINERY



NEW AND IMPROVED
ENGINE LATHES.
THE MULLER MACHINE TOOL CO.
179 West Pearl St., CINCINNATI, OHIO.
Send for Cuts and Prices.

L. S. STARRETT,
Manufacturer of
FINE TOOLS
ATHOL, MASS.
SEND FOR FULL LIST.



The Almond Coupling
A new quarter turn motion to replace quarter turn belts or bevel gears.
T. R. ALMOND, Mfr.,
83 & 85 Washington Street.
BROOKLYN, N. Y.

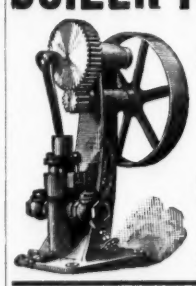
WHAT IS SAID OF
DIXON'S AMERICAN GRAPHITE
=ARTISTS' PENCILS=
MANUFACTURED BY
JOS. DIXON CRUCIBLE CO., Jersey City, N.J.
We find them equal to any we have yet used. PANCOAST & MAULE, Phila.
We find them generally satisfactory.
THE YALE & TOWNE MFG. Co. Stamford, CONN.
*** It will pay every reader of this paper to send 16 cents in stamps to the JOSEPH DIXON CRUCIBLE CO., of Jersey City, N. J., for Samples. By mentioning this paper, they will receive Pencils worth double the money.

FRICTION
CLUTCH PULLEYS AND CUT-OFF COUPLINGS.
JAS. HUNTER & SON,
North Adams, Mass.

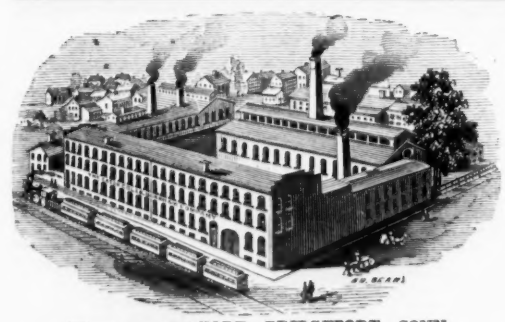
FLUOR SPAR
THE BEST
FOUNDRY FLUX
A natural product taken from our own mines. Unlike any of the artificial compounds or manufactured products heretofore on the market. We guarantee its success if directions are followed, or ask no pay. Only 8 or 10 pounds to the ton of iron required to purify the iron, and will more than pay for itself in keeping the cupola clean. The best flux for foundry work; also used in reduction and refining of silver, copper and lead. Used by glass manufacturers in making opaque ware. Used by chemists in making hydro-fluoric acid for etching ornamented glass. Can be used in manufacturing steel by the basic process.
THE EVANSVILLE LEAD AND SPAR MINING CO.
Successors to B. BURBANK & CO.
Send for circular, prices and experience of users. EVANSVILLE, IND.

BEVEL GEARS,
Cut Theoretically Correct.
For particulars and estimates apply to
BREHMER BROS.
Machinists,
440 N. 12th St., Philadelphia, Pa.

BOILER FEED PUMP



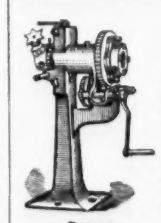
MADE BY
M. R. MUCKLE, Jr. & CO.
PHILADELPHIA,
SIZES TO SUIT STEAM PLANTS, UP TO 300 H. P.
Send For CirculaR



VIEW OF FACTORY, BRIDGEPORT, CONN.

The Eaton, Cole & Burnham Co.,
82 & 84 FULTON STREET, NEW YORK,
Manufacturers of
PIPE CUTTING and THREADING MACHINES,
Operated by Hand or Power.
FITTINGS,
VALVES, PIPE, PIPE TOOLS,
and all styles of
Iron and Brass Goods
For STEAM, WATER and GAS.

W. C. YOUNG & CO., Worcester, Mass. Manufacturers of
Engine Lathes, Hand Lathes,
FOOT POWER LATHES, SLIDE RESTS, Etc.

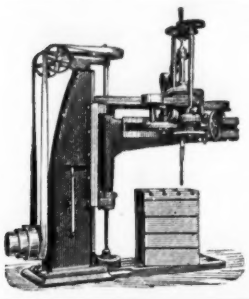


"ECLIPSE" Pipe-Cutting Machines
FOR HAND OR POWER.
Don't you have sufficient Pipe-Work about your Mill, Factory, or Shops to make a powerful, convenient and very compact Pipe-Cutting Machine soon pay for itself, providing it could be had at a moderate price? Mention this paper and write us for particulars.
PANCOAST & MAULE, Philadelphia, Pa.
Made in Three Sizes. Cutting Pipes ¼ to 6 inch.

WHITNEY'S NEW RATCHET.

Has greater range than any other two ratchets made, and at the price of one. Send for circulars.
VARIETY MACHINE CO., Warsaw, N. Y.

USE THE Mason Reducing Valve FOR CONSTANT PRESSURE
Address, MASON REGULATOR CO.
22 Central Street, Boston, Mass.



WILLIAM SELLERS & CO. INCORPORATED,

Engineers and Manufacturers of

IMPROVED MACHINE TOOLS FOR WORKING IRON AND STEEL

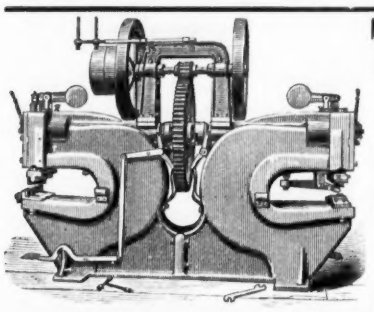
STEAM HAMMERS, PUNCHES and SHEARS, LATHES, PLANERS, BENDING ROLLS, BORING and TURNING MILLS, DRILL and TOOL GRINDERS, Etc., Etc.

SHAFTING, PULLEYS, HANGERS, COUPLINGS, Etc.

Improved Injectors for Feeding Boilers.

PAMPHLETS, PHOTOTYPES AND PRICES FURNISHED ON APPLICATION TO

OFFICE AND WORKS, PHILADELPHIA. PENN.



THE LONG & ALLSTATTER CO. Hamilton, OHIO.

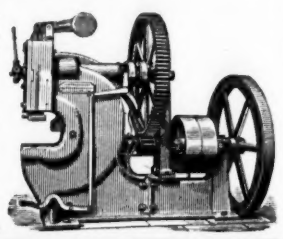
Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven

Punches and Shears.

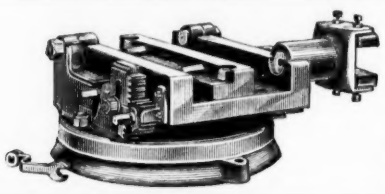
Over 300 Sizes.

ALSO,

Power Cushioned Hammer.



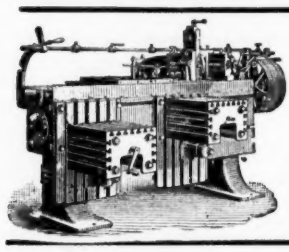
Send for new Catalogue.



Greenwood's Universal Planer Chuck.

For Straight, Curved (Concave or Convex), or Angle Work. Used on any Planer with Cross-Feed for Links, Wedges, Keys, etc. Indispensable for Locomotive Builders and Master Mechanics. Circulars with full description on application.

PEDRICK & AYER, - Philadelphia, Pa.



HOYT & BROTHER MANUFACTIURNG COMPANY,

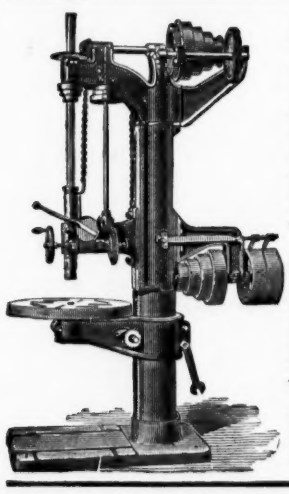
Aurora, Ills., April 17, 1886.

E. A. WALKER,

75 Laurel Street, Philadelphia, Pa.

DEAR SIR:—The Combination Planer we purchased of you the latter part of 1884, is regarded as one of the most satisfactory tools in our shop. Is exceedingly well made and has a wonderful range for work. It gratifies us to add this merited testimonial to your Planer. Yours respectfully,

C. L. HOYT, President.

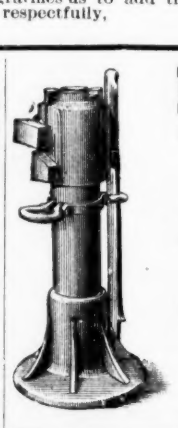


UPRIGHT DRILLS

A SPECIALTY,

ALL SIZES WITH PATENT QUICK RETURN FEED AND ALL MODERN IMPROVEMENTS,

H. BICKFORD, Cincinnati, Ohio.



Hydrostatic Machinery

PRESSES, PUMPS, PUNCHES,

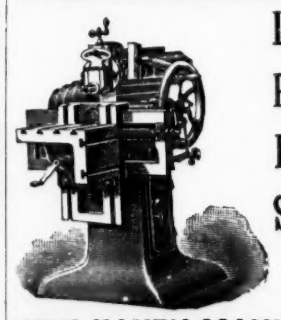
ACCUMULATORS

JACKS, VALVES, FITTINGS,

Vault Elevators, Etc.

WATSON & STILLMAN,

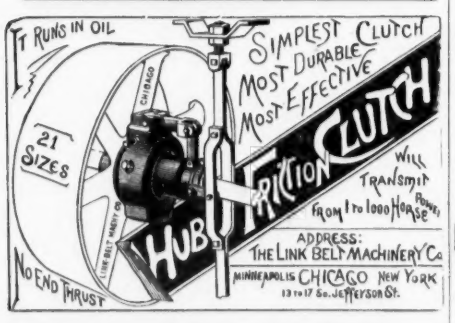
204-210 E. 43d St., New York.



LATHES, PLANERS, DRILLS, SLOTTERS, Etc.

NEW HAVEN MANUFAC'G CO.,

New Haven, Conn.



WOOD-WORKING MACHINERY

For Planing Mills, Furniture, Chair and Cabinet Factories, Cabinet Works and General Wood-Working. Send Stamp for Illustrated Catalogue to

Rollstone Machine Co.

45 WATER ST.,

FITCHBURG, MASS.

HOISTING ENGINES.

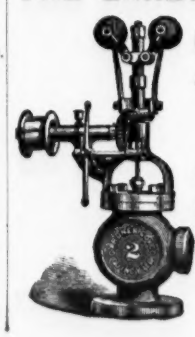
Of any power and Style. SINGLE AND DOUBLE CYLINDER, with improved patent friction drums, especially adapted for bridge building, dock building, pile driving coal hoisting, quarries, mines, etc.

J. S. MUNDY,

Newark, N. J.

This patent has been sustained in U. S. Courts in New York and N. J.

THE GARDNER GOVERNOR



Over 45,000 in Use.

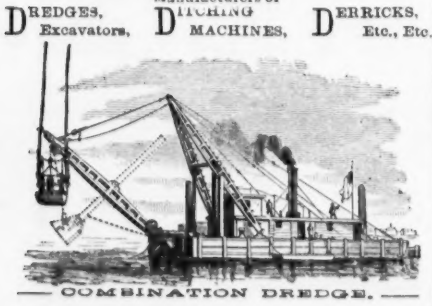
ADAPTED TO EVERY STYLE OF STATIONARY AND PORTABLE STEAM ENGINE.

Warranted to give satisfaction or no sale.

FOR CIRCULARS AND PRICES, ADDRESS,

The Gardner Governor Co,

QUINCY, ILL.



COMBINATION DREDGE.

OSGOOD DREDGE CO., - ALBANY, N. Y.

RALPH R. OSGOOD, Pres. JAMES H. BLESSING, Vice-Pres.

JOHN K. HOWE, Secretary and Treasurer.

Manufacturers of

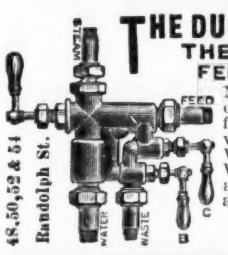
DREDGES, Excavators, DITCHING MACHINES, DERRICKS, Etc., Etc.

SOUTHWARK FOUNDRY & MACHINE CO.

PHILADELPHIA, PA.

General Machinists, Founders and Boiler Makers.

Heavy Machinery of all kinds a Specialty.



THE DUPLEX INJECTOR

THE BEST BOILER FEEDER KNOWN.

Not liable to get out of order. Will lift water 25 feet. Always delivers water *hot* to the boiler. Will start when it is hot. Will feed water through a heater. Manufactured and for sale by

JAMES JENKS & CO.,

Detroit, Mich.

— OUR —

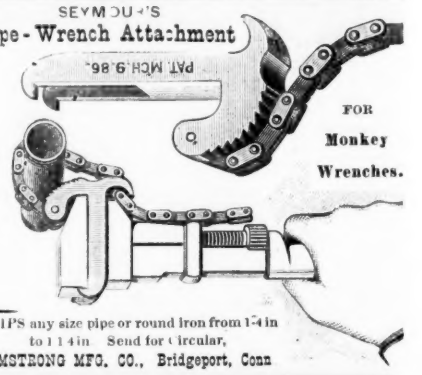
NEW CATALOGUE OF TOOLS

and Supplies sent free to any address on receipt of Ten Cents in stamps (for postage).

CHAS. A. STRELINGER & CO., Wood Ave., Detroit, Mich.

SEYMOUR'S

Pipe-Wrench Attachment



FOR **Monkey Wrenches.**

GRIPS any size pipe or round iron from 1/4 in to 1 1/4 in. Send for Circular,

ARMSTRONG MFG. CO., Bridgeport, Conn

J. WENDELL COLE, M. E.

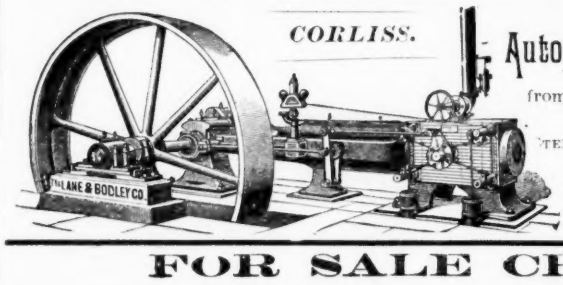
Manager of Pennsylvania Southern Lake regions and the Northwest for

DETROIT EMERY WHEEL CO.

Address, Box 84, Columbus, O., or P. O. Box 152 Chicago.

Hart's Corundum-Emery Wheels.

The Lane & Bodley Co.



MANUFACTURERS OF

Automatic Cut Off Engines,

from heavy patterns and of unexcelled workmanship.

STEEL BOILERS, FEED WATER HEATERS, SHAFTING, PULLEYS & GEARING.

THE LANE & BODLEY CO.

East side John, cor. Water, Cincinnati, O.

FOR SALE CHEAP.

Two 35 Horse Power Demphield Boilers.
One 10 Horse Power Horizontal Tubular Boiler.
Two 27 Horse Power Vertical Boilers - - - - New.
One 25 Horse Power Horizontal Slide Valve Engine.
One 20 Horse Power Horizontal Slide Valve Engine.

REMINGTON MACHINE CO. Wilmington, Del.

THE

Slate Sensitive Drill

Adapted to rapid work with small drills. Its extreme sensitiveness prevents clogging and breakage of drills. Has a switching table with attachment for center drilling. Instantly adjustable to different lengths of work. Over 200 already in use. Send for circular.

DWIGHT SLATE,

Hartford, Conn.

STANDARD PUNCHES FOR

IRON & STEEL PLATES.

Will not Warp.
Will not burn off at the ends.
Will give absolutely 70% air space.
Will give uniform combustion of fuel.

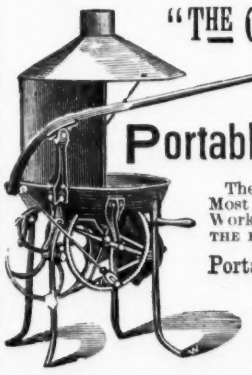
Send for Circular and Price List to

ALEXANDER TRAUD,

EAST FERRY STREET IRON WORKS

NEWARK, N. J.

"THE ONLY PERFECT" BUFFALO Portable Forges,



The Lightest, Strongest, Most Durable, Easiest Working, and in every way THE BEST Portable Forge Made.

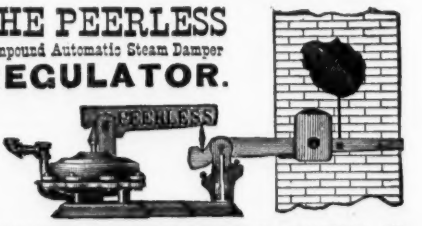
Buffalo Forge Co.,

BUFFALO, N. Y.

THE PEERLESS

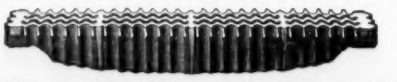
Compound Automatic Steam Damper

REGULATOR.



GUARANTEED THE BEST SAVER OF FUEL IN THE MARKET.

Has been used six years by 700 of the largest mills and firms in the U. S.; not one given out. Always put up by our own mechanics. Warranted to keep in order 5 years. Send for printed testimonial of large users.



THE PEERLESS GRATE BAR.

Warranted not to Warp, and the Most Durable in Use.

American Steam Appliance Co.

W. A. SIMMONS & CO., Sole Agents,

280 Broadway, New York, 22 & 24 N. 4th St., Phila.

MORSE ENGINEERING CO.

1306 Union Avenue, Kansas City, Missouri

GENERAL AGTS. FOR THE SOUTH WEST.

THE NEW YORK Supply Co.

LIMITED.

MACHINISTS,

ENGINEERS AND MILL

SUPPLIES.

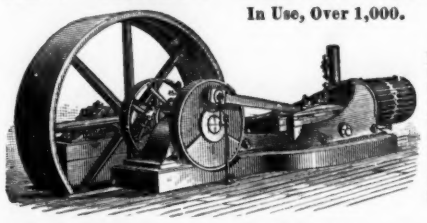
Ashton "POP" Safety Valve.

EXCLUSIVE AGENTS,

50-52 John Street, - New York.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use, Over 1,000. 25 to 1,000 H. P.



These Engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H P for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine construction and performance, free by mail. Address, BUCKEYE ENGINE CO., Salem, Ohio.

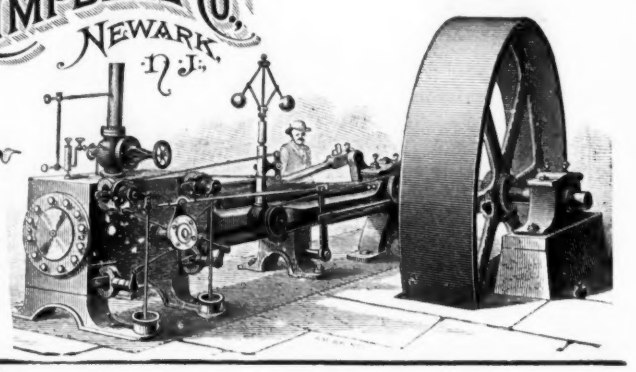
SALES AGENTS: W. L. SIMPSON, 70 Astor House, N. Y. { N. W. ROBINSON, cor. Clinton & Jackson Sts., Chicago, Ill. ROBINSON & CARY, St. Paul, Minn. PRAT MFG. CO., Minneapolis, Minn.

KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA,

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.

THE WATTS, CAMPBELL CO., NEWARK, N. J.

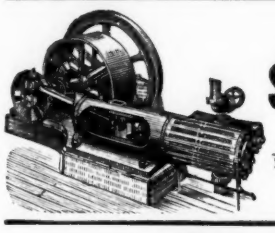
MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.



Sizes Varying From 30 to 2000 Horse Power.

Horizontal or Vertical, Direct Acting or Beam, Condensing, Non-Condensing or Compound.

Send for Circular.



THE BECKETT & McDOWELL MFG. CO.,

STEAM ENGINES, HOISTS, PUMPS,

AND GENERAL MINING MACHINERY.

120 LIBERTY ST., NEW YORK.

☞ SEND FOR ILLUSTRATED CATALOGUE.

HEWES & PHILLIPS Iron Works.

IMPROVED

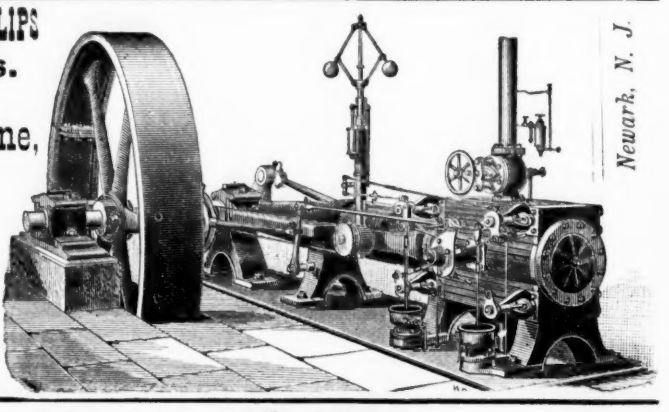
Corliss Engine,

High Pressure, —Condensing— And Compound

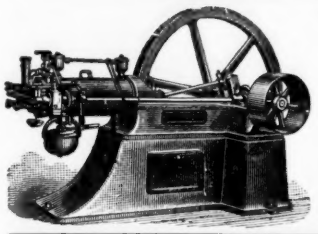
Send for Circular.

AGENT

Geo. A. Barnard. (175 Temple Court) 7 Beekman Street, NEW YORK.



Newark, N. J.



"OTTO" GAS ENGINE WORKS.

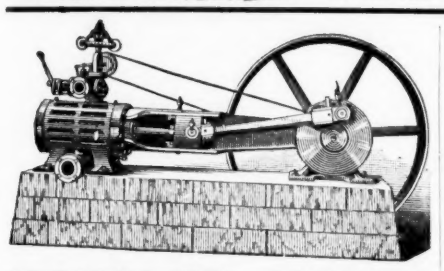
SCHLEICHER, SCHUMM & CO.,

33d and Walnut Sts. PHILADELPHIA.

Branch Office, 130 Washington St. CHICAGO.

OVER 18,000 ENGINES IN USE.

GUARANTEED To Consume 25 to 75 Per Cent. Less Gas than ANY Other Gas Engine per Brake-horse-power.



STEARNS MFG. COMPANY,

ERIE, PA.

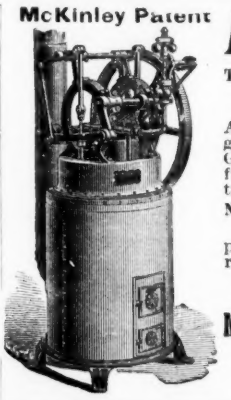
Engines from 15 to 400 Horse Power.

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogues.

SAW MILLS and GENERAL MACHINERY.

Works at ERIE, PA.

McKinley Patent



Air Engine.

The Best and Cheapest on the Market.

No Steam. No Water. Absolute Safety. No Engineer. No Pumps. No Gauges. No liability to freeze up. No Regulation required.

NO EXTRA INSURANCE.

Can be used for any purpose where power is required.

Cheap Fuel. Cheap First Cost.

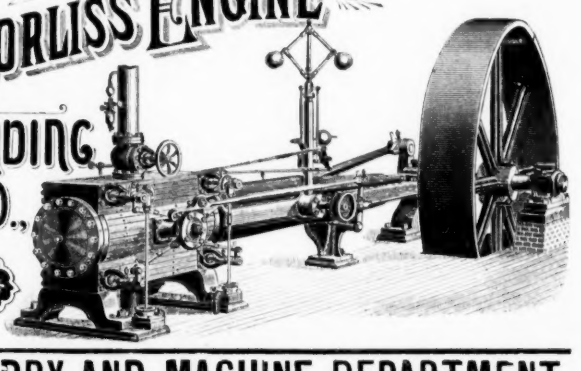
McKinley Engine Co.

17 Broadway, CINCINNATI, O.

THE IMPROVED FISHKILL CORLISS ENGINE

BUILT BY THE FISHKILL LANDING MACHINE CO.,

FISHKILL ON THE HUDSON, N.Y.



THE SKINNER ENGINE CO.

ERIE, PA.

PORTABLE AND STATIONARY

ENGINES and BOILERS

Send for Catalogue and Prices.

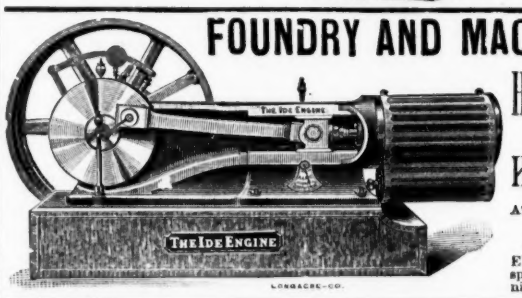
THE NATIONAL FEED WATER

HEATER.

A brass coil heater supplying feed water at 210° to 212° Fahrenheit by use of exhaust steam. Our prices are low and reasonable, and we aim to supply the *cheapest, best and most effective Heater in the market*. Sixteen sizes. 10 H P., $20; 100 H. P., $150; 500 H P., $6.0. Iron, Brass and Copper Coils and Bends made to order. Circulars and price lists sent on application.

National Pipe Bending Co. NEW HAVEN, Conn.

FOUNDRY AND MACHINE DEPARTMENT,



HARRISBURG CAR MFG. CO.

HARRISBURG, PA.

Highest Award Silver Medal AND Diploma AT FRANKLIN INSTITUTE NOVELTY EXHIBITION, PHILADELPHIA.

We are operating the finest and most successful Electric Light Stations in the world. A change of speed not exceeding one per cent guaranteed, running Light and loaded. Send for catalogue.

FAY & SCOTT, DEXTER, ME.

MANUFACTURERS OF

WOOD LATHES,

Drill Lathes, Shaping Machines, Milling Machines, Planer Centers, Etc.

SEND FOR CATALOGUE.

IRON & STEEL DROP FORGINGS

Made to Order.

LOW PRICES AND GOOD WORKMANSHIP

ADDRESS:

BRADLEY & PIERSON MFG. CO.,

Foot of Clay Street, Newark, N. J.

THE ALBANY STEAM TRAP CO.'S

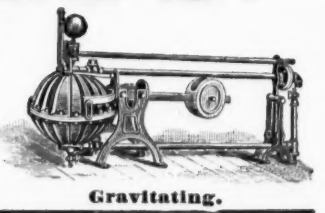
BUCKET AND GRAVITATING

TRAPS.

Bucket.

Automatically drain the water of condensation from HEATING COILS and return it to the boilers whether the coils are above or below the water level in boiler, doing away with pumps and other mechanical devices for such purposes.

We also manufacture Blessing's Patent Renewable Seat Stop and Check Valves.—Send for Circular.



Gravitating.

Albany Steam Trap Co. Albany, N. Y.

MACHINERY,

NEW AND SECOND-HAND.

12 in S., 5 ft. Bed Engine Lathe, New
13 in x 6 ft. Bed Engine Lathe, Ames, new.
14 " 5 and 7 ft. Bed Engine Lathe, Bogert new
14 " 5½ ft. " " " Harris, cheap
16 " 6 ft. " " " Ames
15 " 6 ft. " " " Pratt & Whitney.
17 " 6 ft. " " " Putnam, not screw cutting
17 " 6', 7' " " Hewes & Phillips.
19 " 10.12,14" " " Pond, nearly new.
20 in. x 6 ft. Engine Lathe Putnam, good order.
24 " 20 ft. " " " Ames new
29 " 12 ft. " " " Harrisburg.
34 " 12 ft. " " " Harrisburg, good.
16x6 ft. Turret Fox Lathe with chasing bar
14 in.-20 in. and 33 in. Turret Head Chucking, or Screw Machines, Bridgeport.
23 in., 25 in. and 28 in. Drills, Blaisdell, new.
20 in. Drill, Prentice.
20 " " Davis.
Slate's Sensitive Drill.
Elliott Drill. Gang Drill.

SHAPERS.

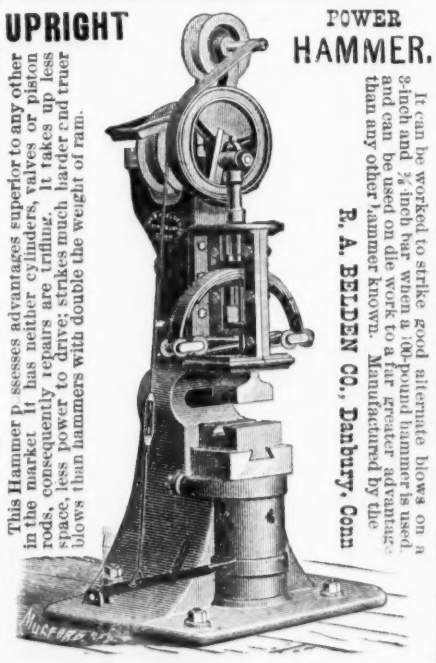
8 in. Gould. 12 in Sellers.
8 in. Boynton & Plummer
15 & 24 in. Wolcott.
20 in. Bridgeport

PLANERS.

16x42 in. Bridgeport.
22 in. x 6 ft. Planer Pratt & Whitney.
24 in x 6 ft., Powell. 24 in x 8 ft. Ames.
26 in x 6&8 ft., " 22 in x 4 ft ,5 ft. and 6 ft. Powell.
32 in x 10 ft , Pond 34in x 10 ft . P & W.
36 in. x 36 in. x 12 ft. Planer, D.W. Pond. A 1 order.
36 in. Squaring Shear, power, nearly new.
No. 3½ and 5 Press, Stiles
40 lb. Bradley Cushioned Hammer.
Lot of miscellaneous Machinery If you do not see what you want, write and state what is required.

.P. BULLARD, 14 Dey St., New York.

UPRIGHT POWER HAMMER.



This Hammer possesses advantages superior to any other in the market. It has neither cylinders, valves or piston rods, consequently repairs are trifling. It takes up less space, less power to drive; strikes much harder and truer blows than hammers with double the weight of ram.

It can be worked to strike good alternate blows on a 2-inch and ⅝-inch bar when a 100-pound hammer is used and can be used on die work to a far greater advantage than any other hammer known. Manufactured by the

R. A. BELDEN CO., Danbury, Conn

2ND HAND MACHINERY FOR SALE by the Hewes & Phillips Iron Works, NEWARK, N. J

One 12x30 Automatic Cut-Off Engine.
One 60-inch x 6-inch x 22ft Planer. Two Heads on Cross Rail
Two 18in. stroke Shapers

CHARLES MURRAY ENGRAVER ON WOOD

58 ANN ST. NEW YORK.

SECOND-HAND TOOLS FOR SALE by POOLE & HUNT, Baltimore, Md.

1 Planing Machine. Will plane 35in. wide, 27 in high, and 16 ft. 6 in. long.
1 Planing Machine. Will plane 30 in. wide, 26 in. high, and 5 ft 6 in long.
1 Planing Machine Will plane 24 in. wide, 22 in. high, and 5 feet long.
1 Double Geared Chasing Lathe. Will swing 24 in. dia., 8 ft 6 in. long.
1 Drill Grinding Machine.
1 Small Punching and Shearing Machine, with fly wheel and clutch starting arrangement.

EXTRA HEAVY LATHE

WE ARE MAKING A SPECIALTY OF A 24-INCH LATHE, WITH BED ANY LENGTH DESIRED. THIS LATHE IS DESIGNED FOR SEVERE SERVICE; IT IS THE HEAVIEST OF ITS SIZE EVER PRODUCED, AND THE WORKMANSHIP AS GOOD AS SKILL CAN MAKE IT.

SEND FOR CIRCULAR.

S. S. HEPWORTH & CO., "Glenwood Station," Yonkers, N. Y.

SEND FOR SPECIAL LIST.

New and Second-hand Machinery.

COLD-ROLLED SHAFTING, HANGERS, PULLEYS, ETC., ETC.

GEORGE PLACE MACHINERY CO.

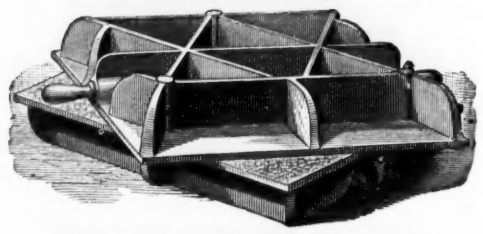
121 Chambers St., New York.

BROWN & SHARPE MFG. CO.,

MANUFACTURERS OF

MACHINERY AND TOOLS

PROVIDENCE, R. I.

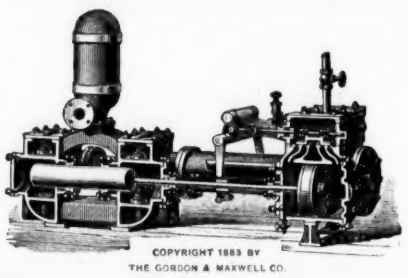


SIZES OF SURFACE PLATES.

4½ in. x 6 in.	9 in. x 9 in.	12 in. x 12 in.	16 in. x 16 in.
6 in. x 6 in.	9 in. x 14 in.	12 in. x 18 in.	18 in. x 18 in.
6 in. x 12 in.	10 in. x 15 in.	14 in. x 14 in.	18 in. x 36 in.
6½ in. x 18 in.	10 in. x 30 in.	14 in. x 18 in.	24 in. x 24 in.

36 in. x 66 in.

Illustrated Catalogue Mailed on Application



COPYRIGHT 1883 BY THE GORDON & MAXWELL CO.

Duplex Steam Pumps

—AND—

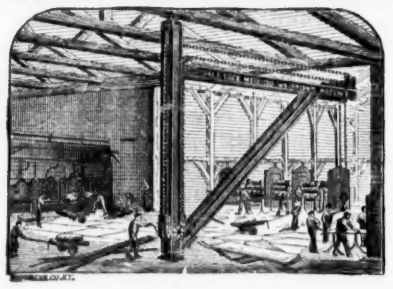
WATER WORKS MACHINERY.

THE GORDON & MAXWELL CO.

HAMILTON, OHIO.

BRANCH HOUSES:

NEW YORK, 96 Liberty Street.
PHILADELPHIA, 713 Chestnut Street.
CHICAGO, 96 Lake Street.



JIB CRANE.

JIB CRANES,

ANY CAPACITY.

FOR HAND OR POWER.

Particulars on application Full Specification and Tender promptly submitted on receipt of capacity, height from floor to support overhead and radius required.

SOLE MAKERS,

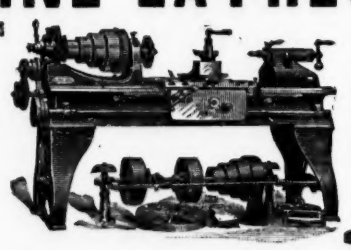
The Yale & Towne Mfg. Co.

STAMFORD, CONNECTICUT.

New York—Chicago—Philadelphia—Boston. Catalogues on application.

SHAPERS, ENGINE LATHES AND DRILLS

Send for Prices, IT WILL PAY YOU.



TWENTY IN. LEVER DRILL.

LODGE, DAVIS & CO.

CINCINNATI, OHIO.

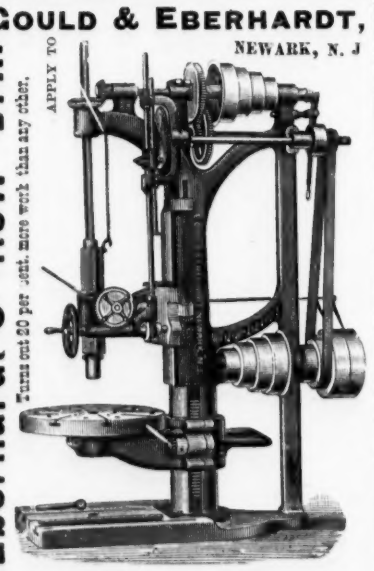
E. GOULD & EBERHARDT,

NEWARK, N. J

Eberhardt's New Drill

Turns out 50 per cent. more work than any other.

APPLY TO



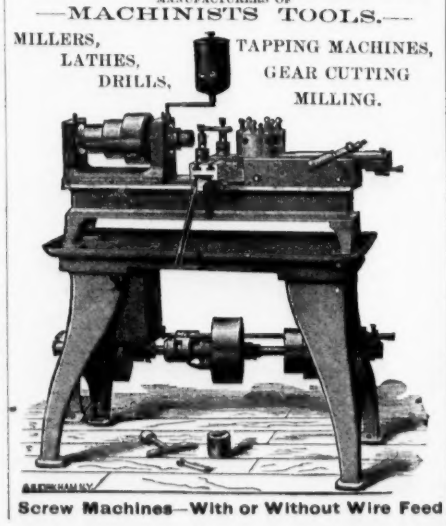
E. E. GARVIN & CO.

No. 139, 141, 143 CENTRE STREET, NEW YORK.

MANUFACTURERS OF

—MACHINISTS TOOLS.—

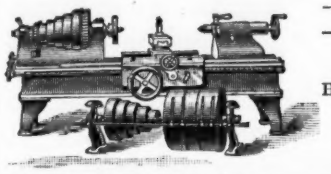
MILLERS, LATHES, DRILLS, TAPPING MACHINES, GEAR CUTTING MILLING.



Screw Machines—With or Without Wire Feed

THE PRATT & WHITNEY CO.,

HARTFORD, CONN.,



Manufacture LATHES of Various Sizes

AND OF THE FOLLOWING KINDS:

HAND, ENGINE FOR TURNING AND SCREW CUTTING CUTTING OFF, GAP BED, PULLEY TURNING AND BORING, TURRET-HEAD ENGINE AND CHUCKING, HAND WHEEL, RIM TURNING, SPINNING, GRINDING, PATTERN MAKING, &c.

CHARLES H. BESLY & CO., Western Agents, 175 Lake St., Chicago Ill, U. S. A.

THE BILLINGS AND SPENCER CO., HARTFORD, CT., U. S. A.

MANUFACTURERS OF

BILLINGS' DOUBLE-ACTING

RATCHET DRILL

For Morse Taper Shank Drills.

Packer Ratchet Drills.

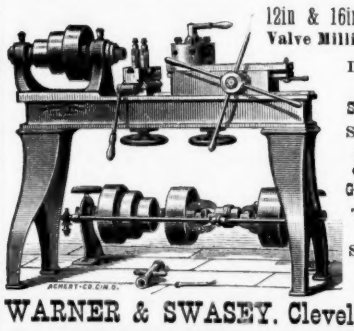
Packer Boiler Ratchet Drills,

Packer Auger Ratchet Drills,

DROP FORGINGS

OF EVERY DESCRIPTION.

BRASS WORKING MACHINERY.



12in & 16in. McNeil's Valve Milling Mach's

Double Key Lathes,

Speed Lathes

Slide Rests,

Revolving Chucks for Globe Valves,

Two-Jawed Chucks,

Small Tools and Fixtures.

WARNER & SWASEY. Cleveland, O.

READY

For Immediate Delivery.

AXLE LATHES

for Turning Car and Locomotive Axles.

LATHE

for Turning Steel Tired and Chilled Cast Iron Car Wheels, two at same time without removal from axle.

POND MACHINE TOOL CO.

MANUFACTURERS OF

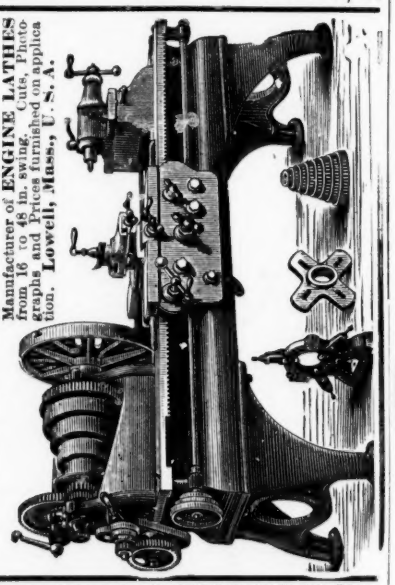
STEEL and IRON WORKING

MACHINE TOOLS.

WORCESTER, MASS.

GEO. W. FIFIELD,

Manufacturer of ENGINE LATHES, Photo Cuts, Photographs and Prices furnished on application. Lowell, Mass., U. S. A.

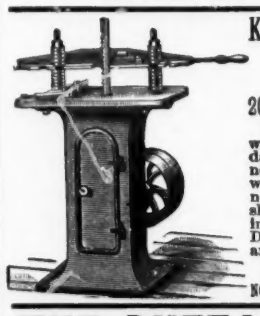


GEAR WHEELS & GEAR CUTTING.

Send for Catalogue D.

GEORGE B. GRANT,

666 Beverly Street, Boston.



KEY-SEATING MACHINES AND 20-in. Drills a Specialty.

Our Key-Seating Machine will save enough in 60 days' use to pay first cost; no shop can afford to do without one. We have now ready for prompt shipment, both Key-Seating Machines and 20-inch Drills. Send for Photo. and Catalogue.

W. P. DAVIS,

NORTH BLOOMFIELD, N. Y.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

HARTFORD, CONN.

J. M. ALLEN, PRESIDENT.

W. B. FRANKLIN, VICE-PRESIDENT.

J. B. PIERCE, SECRETARY.

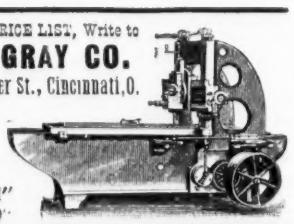
For New Reduced PRICE LIST, Write to

THE G. A. GRAY CO.

Sycamore & Webster St., Cincinnati, O.

Lathes, 17 in. 20 in.

Planers, 24"x24" 30"x30"



THE BUFFALO STEEL FOUNDRY, BUFFALO, N. Y.

ORDERS AND CORRESPONDENCE SOLICITED.

PRATT & LETCHWORTH Proprietors.

The Stiles Machinist Tool Grinder.

FOR GRINDING LATHE, PLANER AND OTHER TOOLS,

—MANUFACTURED BY—

THE STILES & PARKER PRESS CO.

MIDDLETOWN, CONN.

Branch Works and Office:

203, 205, 207 Centre Street, corner of Howard, New York

J.M.CARPENTER PAWTUCKET.R.I.

Manufacturer —of— TAPS AND DIES